

Time to Repay or Time to Delay?
The Effect of Having More Time Before a Payday Loan is Due^{*}

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Abstract:

Payday-loan borrowers pay sizable fees for short-duration loans and often borrow repeatedly. We explore the effects of longer loans, exploiting regulations that give some borrowers an additional pay cycle to repay their initial loan without increased interest charges. We show theoretically that while an exponential discounter would use this “grace period” to save and smooth consumption, naïve borrowers with sufficient present-bias would not because they procrastinate on making consumption sacrifices when due dates are distant. Consistent with predictions under naïve present bias, borrowers with longer loans did not make larger initial loan payments and had similar repeat borrowing patterns.

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A concern often raised about short-term subprime loans, such as payday loans, is that short loan periods make it difficult for people to save for repayment and consumption smooth, leading to a cycle of repeat borrowing.¹ We explore how payday-loan borrowers' repayment patterns are affected by having more time, an additional pay cycle, before a loan comes due when that additional loan duration does not come with additional interest fees. In theory, this opportunity to engage in consumption smoothing and saving over a longer period should be quite valuable. However, if people are present-biased and procrastinate on making sacrifices for the future (Laibson, 1997; O'Donoghue and Rabin, 1999 and 2001), there may be little benefit to having more time to prepare for loan repayments and other anticipatable expenditures.

We explore this question using a large administrative dataset on the repayment patterns of payday-loan borrowers in Texas who faced different amounts of time to repay their loans. Regulations in Texas during the timeframe of our data created variation in loan durations with no changes to other contract terms. The duration of a payday loan had to be at least seven days - due on a payday - and the interest charges were 18% of the principal, irrespective of the length of the loan. Since these loans mature on the borrower's payday, this meant that if a borrower originated a loan seven days before their next pay date, their initial loan would be seven days. A similar borrower who came in one day later would have until the end of their *next* pay period before the loan was due (we call this a "grace period"). For two borrowers paid biweekly, this scenario resulted in one borrower having an initial loan length of seven days, while the other had 20 days (and an intervening pay date), with no difference in their total interest charge. Any subsequent borrowing (i.e., loan rollovers) had loan durations of two weeks for both types of borrowers. We

¹ For example, Richard Cordray as director of the Consumer Financial Protection Bureau noted concern with repeat payday-loan borrowing: "Trouble strikes when [borrowers] cannot pay back the money and that two-week loan rolls over and over and turns into a loan that the consumer has been carrying for months and months." <http://www.consumerfinance.gov/speeches/remarks-by-richard-cordray-at-the-payday-loan-field-hearing-in-birmingham-al/>.

exploit this variation in whether or not the initial loan has this “grace period” to explore how additional time before a loan payment is due affects behavior for these subprime borrowers.

We begin by developing a simple model of consumption and debt repayment that allows us to develop intuition for how a “grace period” of this type might affect repayment behavior. The model is quite standard except that it incorporates binding pay-period-level budget constraints that capture the dynamics of payday loan repayment. In the model, borrowers may express some level of naïve present-bias (Laibson, 1997; O’Donoghue and Rabin, 1999), allowing the model to embed both classic exponential discounting and a leading model of time inconsistency.

The model predicts that the effects of having a grace period will depend on the extent to which the borrower is present biased. For time-consistent borrowers with no present bias and plausible exponential discount factors, the model predicts that people will take advantage of having an extra pay period before their loan is due to smooth consumption over more days. Time-consistent borrowers use the grace period to save and make larger first loan payments, ultimately reducing their total interest charges over the course of the loan. However, the grace period has less effect for borrowers with higher levels of naïve present bias. As present bias rises, the size of the first loan repayment for borrowers with a grace period falls to match that of those with no grace period. The model predicts that present-biased borrowers end up essentially “wasting” the grace period and engage in no additional saving for loan repayment during that time. The intuition for this result is that even modest levels of present bias causes short-run impatience that leads to procrastination so that most of the consumption reductions that go toward repaying debt occur near to loan repayment deadlines. When that procrastination effect is strong enough, adding additional time before the loan is due has very little effect on the debt-repayment patterns.

The goal of our empirical analysis is to estimate the effect of a grace period on these repayment patterns. The primary challenge to the empirical exercise is that the decision of when

to come in for a payday loan is endogenous. We present evidence, however, that borrowers appear unsophisticated in their timing of when to come in for loans and that the variation in loan durations is plausibly exogenous. In particular, we show that there is no spike in borrowers taking advantage of longer loans by coming in after the threshold when they would get the grace period. We also find that borrowers who come in just before and just after the seven-day discontinuity point are very similar on a broad range of important characteristics, such as loan size, credit score, and income. These patterns give us confidence in using the variation in loan duration for borrowers around this cutoff to estimate the effect of having more time to repay an initial loan.

Consistent with the predictions the model gives for naïve present-biased agents, we find that borrowers take very little advantage of the grace period. On average, borrowers with biweekly paychecks took out initial payday loans of \$300 and repaid an average of \$54 in interest charges and \$89 of the principal at the initial due date. We estimate that having an additional pay period had essentially no effect on the amount repaid at the initial due date with the 95% confidence interval excluding additional payments of more than \$3. Similarly, the number of times loans were rolled over and the total interest charges were only modestly lower for borrowers who have more time to repay the initial loans.

These findings have implications for economic policy for subprime loan products. Some states have introduced regulations that increase the length of time borrowers have to repay their loans.² Our results suggest that for many there may be relatively little benefit from having longer to repay debt per se. These policies may instead largely keep borrowers indebted longer without substantial harms or benefits.

² For example, in 2009 Virginia began requiring that payday borrowers be given at least two pay cycles (rather than the typical one) to repay their loans. See: http://www.scc.virginia.gov/bfi/files/payday_rept_09.pdf

Our findings also contribute to our understanding of the behavioral foundations of subprime borrowing. While classical economic theory predicts that access to a voluntary credit source can only benefit fully-informed consumers, various forms of biases generating myopia might lead people to take on costly debt that is not in their own best interest (Caskey, 2012). Empirical research directly testing the question of whether access to payday loans is beneficial or detrimental comes to mixed conclusions.³ However, research has documented important patterns of myopic behavior among payday-loan borrowers that helps to inform this debate. For example, a field experiment by Bertrand and Morse (2011) with payday loan borrowers found that “information that makes people think less narrowly (over time) about finance costs results in less borrowing.” Burke et al. (2015) find that behaviorally-informed disclosures like those used in the Bertrand and Morse experiment helped Texas borrowers understand the true cost of payday loans. Dobbie and Skiba (2013) document that many payday loan borrowers ultimately default. Skiba and Tobacman (2008) show that default typically occurs after making a long series of interest payments, which is most consistent with models of naïve hyperbolic discounting. Olafsson and Pagel (2016) find that many people borrow on payday loans for immediate consumption on alcohol and restaurants despite having cheaper sources of liquidity available, suggesting this borrowing may relate to self-control problems. The findings in this paper add new empirical evidence supporting the proposition that accounting for consumer myopia is important for those hoping to understand the behavior of subprime borrowers.

³ Melzer (2011) concludes that access to payday loan exacerbates financial difficulties. Carrell and Zinman (2014) also find that access to payday loans harms the job performance of Air-Force personnel, and Skiba and Tobacman (2011) find that payday loans increase personal bankruptcy filings. Other studies, though, have found more positive effects of access to payday loans. Zinman (2010), Morgan et al. (2012), and Bhutta et al. (2016) provide evidence that limiting access to payday loans may push people toward other costly forms of subprime credit, such as overdrafts or pawnshop loans. Morse (2011) finds that payday loans help borrowers who suffered through a natural disaster. Bhutta et al. (2015) find that payday borrowers turn to these loans only after exhausting access to less costly forms of credit, consistent with classic models of liquidity constraints. Yet they also find that these borrowers tend to borrow at high rates for long periods of time suggesting that high-interest borrowing is not relieving temporary credit constraints. Carter and Skimmyhorn (2017) find no effects of access on credit or labor outcomes of Army personnel.

Finally, these findings add to a broader literature documenting empirical patterns of consumption and borrowing behavior that can be more easily rationalized with models of quasi-hyperbolic discounting incorporating time inconsistency than classic exponential-discounting frameworks. These studies include findings related to monthly patterns of food consumption for food-stamp participants (e.g., Shapiro, 2005; Hastings and Washington, 2010), saving and borrowing behavior (e.g., Laibson, 1997; Angeletos et al., 2001; Gross and Souleles, 2002; Meier and Sprenger, 2010), retirement-savings patterns (e.g., Loewenstein et al., 1999; Madrian and Shea, 2001) and monthly patterns of credit card debt repayment (Kuchel and Pagel, 2017). Our study is the first in this series to explore how consumers react to variation in the timing of predictable future expenditures. Like much of this literature, our study does not provide a test of the quasi-hyperbolic model of discounted utility versus other models of consumer myopia.⁴ However, the findings here provide new evidence in support of the value of incorporating these behavioral factors into economic models. Our findings also suggest that using variation in the time that people have to prepare for spending shocks and changes in credit conditions more generally may be a valuable direction for future research aiming to better understand the behavioral foundations of consumption, borrowing, and savings dynamics. In the discussion at the end of the paper we highlight some other settings where exploring these dynamics might be valuable, such as mortgage lending and credit-card borrowing.

⁴ Examples include, temptation (Gul and Pesendorfer, 2001 and 2005), focusing effects (Kőszegi and Szeidl, 2013), or inattention (Shah et al., 2012). In fact, as we discuss below, even exponential discounting with extreme discount rates could help rationalize the lack of repayment response to a grace period. Within the exponential model, however, that degree of short-run impatience implies implausible discounting of the further future (e.g., nearly complete discounting of utility one year out).

2. Background on Payday Loans

Payday lenders supply a few hundred dollars of cash on the spot in exchange for a personal check written to the lender by the borrower, post-dated to an upcoming payday for the borrower.⁵ The due date is typically set for the borrower's next payday or the payday after that, variation which we describe in more detail in Section 4. Unless the borrower comes in to renew and extend the loan, the lender then cashes the check, written for the principal plus fees (including interest), on that payday. The typical \$300 payday loan requires a \$54 interest fee for its short term (e.g., two weeks). Hence, annualized interest rates for these loans are on the order of 400–600 percent.

A key feature of most payday loans, including the ones studied here, is that this interest charge is a fixed percentage of the loan balance over the course of a pay cycle. For example, the \$300 loan has a \$54 interest charge (18%) due at the next pay date, regardless of the length of time in the pay cycle. There is also no prepayment advantage, and as such, there is no true daily interest rate for these payday loans. This distinguishes payday loans from many other types of consumer credit.

Beyond requiring a checking account to obtain a payday loan, a borrower must also verify her employment, identity, and address by providing the lender a recent pay stub, a phone or utility bill, and a valid form of identification. Not all payday borrowers with valid documentation are approved to borrow. Most large lenders, including the one studied here, calculate a subprime credit score they use to approve and reject applications. About 15 percent of all loan applications are rejected based on this score.⁶

When the loan comes due, the borrower has a number of options. She can allow the payday lender to cash her check and pay off the loan that way. She can also go to the lender and repay the

⁵ Repayment via direct withdrawal from the borrower's bank account has become common recently. Repayment with a physical check was the norm during the time frame studied here.

⁶ For more on the subprime scoring process, see Agarwal et al. (2009).

loan in cash. Finally, borrowers can partially or fully “renew” or “roll over” a loan. A loan rollover allows the borrower to pay her interest charge on the due date and renew all or some of the principal for the loan. The renewal extends the maturation date of the loan, requiring an additional interest payment but giving the borrower a subsequent pay cycle to repay the principal (plus the additional interest). Many states restrict this practice, and there are a number of papers that study the chronic behavior of payday loan borrowers.⁷ It is not clear, however, how effective those restrictions on repeat borrowing are generally since monitoring payday borrower behavior is difficult. The data we use comes from Texas during a time period where there were no such restrictions on repeat borrowing for payday loans.

3. Model

In this section we develop a model of debt repayment that matches the essential features of payday loans described above. The model is designed to focus on how the length of time to repay an initial loan, i.e., having a “grace period,” affects repayment patterns under different levels of time discounting. For our primary analysis we intentionally keep the model simple and abstract from other important features of borrowing behavior, including the decision of whether or not to initiate a loan in the first place, the decisions surrounding defaulting on the loan, and the effects of stochastic income and consumption shocks beyond whatever shock that generated the initial need for the loan. However, we return to these issues in Section 6 after presenting our empirical results.

⁷ See for example Bertrand and Morse (2009), Burke et al. (2015), Fusaro and Cirillo (2011), Li et al. (2012), Skiba (2014), and Stegman and Faris (2003) for papers that discuss rollover behavior and borrowers who chronically use payday loans.

3.1 Modeling the loan environment

The crucial feature of the payday lending environment that distinguishes it from other borrowing environments is that payday loans carry fixed interest charges over the period of the loan, rather than daily interest rates. The model in this section is an adaptation of a textbook consumption model modified to account for this type of borrowing.

Consider an agent who receives income y at regular pay cycle intervals (e.g., every 14 days). We index these pay cycles by I and the days within the pay cycle with t . The final day of a pay cycle is denoted with $t = T$. We then denote the consumption on day t of pay cycle I as c_t^I . The payday loan borrower in our model begins the first pay cycle of the model with an initial debt balance (i.e., the initial payday loan) of D^0 . We assume that this initial debt level is the borrowing limit for the individual, which simplifies the model and broadly matches the empirical evidence on payday loans for our sample. For all periods, we can denote the level of debt at the start of the pay period as $0 \leq D^I \leq D^0$. There is a periodic interest rate of r charged on the debt balance and this interest charge comes due at the start of the following pay period. Importantly, as mentioned, in payday lending this interest rate is charged on the entire balance for the pay period regardless of the length of the period and cannot be reduced by pre-paying the loan earlier.

We consider first the “non-grace period” payday loan repayment schedule, in which in every period the loan and interest charge come due at the end of the pay cycle. Next we will discuss the “grace period” dynamics, where borrowers have an extra pay cycle when no interest is due. For the non-grace period repayment schedule the budget constraint in any pay period is given by:

$$rD^I + (D^I - D^{I+1}) + \sum_{t=1}^T c_t^I = y. \quad (1)$$

The first term is the interest payment due on the loan for that period. The second term is the net principal paid down on the loan that period. The final term on the left-hand side of the equation

is simply the sum of daily consumption during the period.⁸ The model also assumes that the interest and principal must be repaid and that default is not an option.⁹

In the “grace-period” case, the initial loan payment is due at the end of the second pay cycle, rather than at the end of the first pay cycle as in the non-grace period case. The budget constraint for the initial “grace-period” pay cycle, $I = 0$, is:

$$S + \sum_{t=1}^T c_t^0 = y, \quad (2)$$

where S denotes savings during the first pay cycle that can be used to help repay the payday loan at the end of the next pay cycle. The savings during the first pay cycle does not earn any interest, which matches the fact that interest payments due on an initial payday loan are fixed and cannot be reduced by repaying part of the loan early. Since the agent is already carrying a payday loan equal to her borrowing limit, there is no possibility of additional borrowing during the grace period.

For the individual with the grace-period, the budget constraint for the following pay cycle, $I = 1$, when the initial loan comes due, is then given by¹⁰:

$$S + rD^0 + (D^0 - D^2) + \sum_{t=1}^T c_t^1 = y. \quad (3)$$

Because the grace period only applies to the initial loan repayment, the budget constraint for all following pay cycles is then given by Equation 1.

⁸ In principle, this general budget constraint could also include a savings term. However, we omit that term here for simplicity since the model would generate no positive savings without adding uncertainty about future income or interest rates on savings that exceed those of the payday loan debt.

⁹ We discuss default in Appendix B, but in some ways our no-default assumption matches how payday loans work because payday loan borrowers write a check when they take out the loan for both the loan principal and interest charge that can be cashed by the lender at the next payday. On the other hand, in practice people can and often do have insufficient balances in their checking accounts, even on payday, causing those checks to bounce and for the loan to be in default. To keep our model simple, we focus on the notion of debt repayment without the possibility of default.

¹⁰ In Equation 3 the term $(D^0 - D^2)$ could be replaced by $(D^1 - D^2)$ because for the grace-period case $D^1 = D^0$.

3.2 Preferences

The utility of the agent from the perspective of any day t is a discounted sum of the utility of (expected) consumption into the future and is given by:

$$U_{t,l} = u(c_t^l) + \beta \sum_{Z \geq l} \sum_{k=t+1}^T \delta^{(k-t+(Z-l)T)} u(\hat{c}_k^Z). \quad (4)$$

The agent at day t believes that utility at all future dates $j > t$ will be given by:

$$\hat{U}_{j,l} = u(c_j^l) + \sum_{Z \geq l} \sum_{k=j+1}^T \delta^{(k-j+(Z-l)T)} u(\hat{c}_k^Z). \quad (5)$$

These preferences are the well-known formulation for a naïve quasi-hyperbolic agent, with notation to account for summation over the utility of future consumption over days in the pay cycle and across different pay cycles. The naïve hyperbolic comes from the lack of β in Equation 5, which implies that the agent wrongly believes that utility from the perspective of future periods will not include present bias. The parameter $0 \leq \delta < 1$ is a standard exponential discounting factor. The present-bias parameter is denoted by $0 \leq \beta \leq 1$ and the preferences embed classic exponential discounting for the case when $\beta = 1$. When $\beta < 1$, the agent has wrong perceptions of future utility, believing that on future days her utility will not involve present bias. The notation \hat{c}_k^Z and $\hat{U}_{j,l}$ denotes the agent's possibly wrong beliefs about consumption and utility in the future. When $\beta = 1$ the agent is time consistent and holds correct beliefs.

We focus on the naïve version of the quasi-hyperbolic model rather than sophisticated version (where the agent is accurately aware of her level of present bias in the future). We use this assumption primarily because Skiba and Tobacman (2008) show that broader patterns of payday loan borrowing behavior are most easily rationalized by the naïve hyperbolic formulation.¹¹

¹¹ We also note that solving this model under sophistication is challenging due to the binding credit constraints in the payday loan environment, which changes the effective interest rates periodically. For a sophisticated agent this creates

3.3 Model predictions

In Appendix A we detail our dynamic-programming approach to solving the model. Because there is no uncertainty in the model, it is a relatively straightforward consumption-smoothing problem. The main challenge to solving the model, and what makes it unique from most models of consumption and borrowing, is that the effective interest rate between consumption today and the future changes over the course of pay cycles. This results from the unique feature of payday loans that interest rates are fixed by pay cycle and not a daily interest rate. The solution to the model is governed then by two underlying Euler equations – one for within-pay-cycle consumption and one for across periods:

$$u'(c_t^I) = \beta\delta u'(\hat{c}_{t+1}^I) \text{ for } t < T, \quad (6)$$

$$u'(c_t^I) = \beta\delta(1+r)u'(\hat{c}_1^{I+1}) \text{ for } t = T. \quad (7)$$

Equation 6 holds within a pay cycle, while Equation 7¹² holds comparing consumption at the end of one pay cycle and the beginning of the following pay cycle. On the right-hand side of both equations is the expected consumption the next day, which for a naïve agent ($\beta < 1$) will generally not match the actual consumption chosen on that following day. The difference in the grace-period case is simply that in Equation 7 at the end of the first pay cycle the interest rate is set to zero because the loan is not due until the following pay cycle.

To explore predictions of the model, we numerically solve for the debt repayment patterns under different degrees of exponential discounting and naïve present bias. For this exercise, we assume that borrowers have log daily utility such that $u(c) = \ln(c)$. We focus on a case where

a sequential game structure where the different daily “selves” are playing a finite game during a pay period, but that finite game structure is embedded within a larger infinite game across pay periods.

¹² Technically, equation (7) has a Lagrangean multiplier associated with the $D^I \leq D^0$ constraint. We choose not to write it out here because under our model parametrization this constraint does not bind unless $\beta\delta_{daily}$ are very small. Our numerical procedure detailed in Appendix A for solving the agent’s problem is robust to small $\beta\delta_{daily}$ values.

the borrower is paid $y = \$900$ biweekly ($T = 14$), the initial debt burden $D^0 = \$300$, and the per-period interest rate $r = 0.18$, all of which match the averages for our sample of payday loan borrowers.

Figure 1 shows the principal payments and the total interest paid on the loan predicted by the model for different levels of present bias. Here we fix the yearly exponential discount factor to be $\delta_{annual} = 0.8$, which implies significant levels of exponential discounting.¹³

The solid lines show the total principal paid off under the non-grace period repayment schedule at the end of the first pay cycle. The dot at the far left of the graph, where $1 - \beta = 0$, is the classic case with no present bias. With no present bias the model predicts that the individual would pay down just under \$200 of the \$300 loan at the first due date. Even though the 14-day interest rate of 18% implies an annualized interest rate of 468%, the individual with an annual discount rate of 20% continues to borrow after the first pay period to facilitate consumption smoothing across the two periods. The debt repayment levels in the non-grace period repayment schedule respond sharply to the level of present bias. As present bias rises, we see that the individual repays the loan more slowly, making smaller initial debt payments and paying off less by the end of the second pay period. If the present-bias discount factor falls to around $\beta = 0.7$ the model predicts that the individual will not pay off the loan at all and will simply carry the maximum debt burden indefinitely, paying 18% interest each period.¹⁴

¹³ This implies a daily discount factor $\delta_{daily} = 0.9994$.

¹⁴ We show in Appendix A Figure A3a that without present bias in the model the repayment patterns are much less sensitive to the level of exponential discounting. For example, with no present bias the initial payment falls modestly from around \$200 to \$150 only once the yearly exponential discount factor falls to an extreme 0.10. In contrast, we can see in Figure 1a that even small amounts of present bias significantly reduce the initial payment amount: the initial payment falls to \$150 for present bias of only $\beta = 0.93$. These results help to highlight a point first made in Skiba and Tobacman (2008) that slow repayment of costly payday loans can be more easily rationalized by models incorporating present bias than those only incorporating exponential discounting.

The dashed line in Figure 1 shows the initial debt repayment when there is a grace period. For low levels of present bias the model predicts that the individual will use the grace period to save and this will increase the initial debt repayment substantially. For example, with no present bias ($1 - \beta = 0$), the model predicts that the initial payment for someone with a grace period will rise to around \$260 (compared to under \$200 in the non-grace period case). While the grace period does not result in the full loan being paid off at the initial due date with these parameters, the amount of debt rolled over after the first due date is substantially lower and hence the additional interest charges beyond the first 18% charge on the initial loan are also substantially reduced. The key insight of the model comes as we look at the dynamics for repayment of someone with the grace period as the level of present bias rises. The initial repayment falls more quickly for the grace-period repayment schedule than for the non-grace period repayment schedule. Once present bias reaches a level of around $\beta = 0.78$, which is not far from the calibration estimates from Angeletos et al. (2001) for the hyperbolic model based on aggregate consumption-savings data, the initial repayment under the grace period exactly matches the initial repayment under the non-grace period repayment schedule. In this case, the agent did no additional saving in the grace period and experienced no reductions in interest charges over the life of the loan (as seen in Figure 1b). Essentially the grace period is “wasted” for present-biased agents and the only effect of the grace period is to push back the repayment patterns by around 14 days.

We can see this pattern in Figures 2a and 2b, which show the debt repayment levels over time for the non-grace period and grace period repayment cycles for the case with either no present bias (2a) or present bias of $\beta = 0.8$ (2b). With no present bias, the loan is repaid quickly and when there is a grace period the initial loan payment is significantly larger with smaller loan payments thereafter. With present bias, however, the loan is both repaid more slowly and the

repayment pattern with the grace period is quite similar to the non-grace period case but pushed out an additional pay cycle into the future.

The intuition for this result is that the naïve-present-biased agents are procrastinating on sacrificing consumption to repay the debt. Present-biased agents prefer to delay sacrifices to the near future. Further, a naïve agent believes that in upcoming days she will pull back on consumption to help repay the debt by more than she actually will. When the due date is far away, these naïve beliefs lead the agent to wrongly conclude that there are low returns to reducing immediate consumption. However, as the due date on the loan approaches, the fact that consumption on prior days was high becomes apparent and it's clear that sacrifices are needed to repay the loan. As such, a naïve present-biased agent engages in most of the consumption reductions that help to repay the loan in the days immediately leading up to the loan due date. Adding additional time before the loan is due in the form of a grace period does not result in any additional saving to help repay the loan. Ultimately, then, the model helps to highlight that to the extent that naïve present-bias helps to rationalize slow repayment of high-interest debt, and other consumer behavior, it also predicts that policies aimed at giving people more time to engage in consumption smoothing may have little effect.

To summarize: the key model prediction is that borrowers with moderate present bias will show a unique pattern of debt repayment when we compare those with and without a grace period. In particular, the model predicts that those with non-grace period repayment schedules make significant repayments at the first due date but that those with grace periods show little to no increase in repayment rates at the first due date.

Finally, we note that an obvious feature missing from this model is the possibility of loan default. Incorporating rich default dynamics would complicate the model and obscure from the simple predictions about repayment patterns. However, in Appendix B we incorporate a simple

extension of the model to allow for non-strategic defaults that arises from surprise expenditure or income shocks. Adding that feature to the model changes none of the repayment predictions, but does predict that default patterns will be different between borrowers with and without grace periods. Grace periods cause borrowers to default less in the first pay period after the loan is originated, but ultimately lead to higher eventual default rates simply because they result in borrowers having loan balances outstanding for longer. That is, the grace period causes the borrower to be in debt longer and hence exposed to the possibility of a surprise shock for longer. This prediction, however, is the same regardless of the degree of present bias in the model and hence is not a prediction of present bias.

4. Data

4.1 Administrative payday-loan data

Our data come from the administrative records of a large payday lender in Texas. We are able to observe information obtained during the application process (take-home pay from latest paycheck, pay frequency, checking account balance, credit score, gender, etc.), as well as characteristics of the loan (origination and maturation date, loan size, interest paid, and whether the loan was renewed, repaid in full, or defaulted on). Our lender is active in 14 states, but we focus on loans originated in Texas because the majority of applications at this lender occur in this state. We also focus on loans originated between November 2001 and August 2004, during which time the lender used stable loan terms and lending requirements. Finally, we restrict our analysis to borrowers who are paid either every two weeks or semimonthly because those borrowers are the ones for whom regulations on minimum loan lengths allow us to employ our empirical strategy

For our analysis, we focus on how initial loan durations affect the patterns of debt repayment. To facilitate that analysis, we identify a sample of “initial loans.” Specifically, we look

for loans taken out when the individual has not had a loan from the lender for some time (32 consecutive days). We define an initial loan in this way to capture borrowers who have not been dependent on a loan for at least two pay cycles. We then analyze the patterns of repayment and rollovers for all the loans that follow this initial loan in a continuous fashion, what we label a “loan spell.”

Table 1 provides summary statistics on the loan and borrower characteristics from our full sample of new loans.¹⁵ We have 79,098 initial loans by borrowers paid biweekly (Col. 1). Including the total number of loans in a borrower’s spell, this amounts to a total of 325,020 loans analyzed. Our main analysis will restrict this sample to those who arrive 6 or 7 days before the payday loan is due (Col. 2) which includes 15,491 initial loans. The average initial loan was from a borrower who was 36 years old, somewhat more likely to be female, and more likely to be a minority (41 percent of borrowers were black and 36 percent Hispanic). Around 76-78 percent of these borrowers use direct deposit to receive their paycheck. Using borrowers’ pay stubs, we estimate that the average loan was originated by a borrower with annual pay, net of taxes, of approximately \$22,500-\$23,000. The average checking account balance from their most recent bank statement prior to obtaining their initial loan was just \$265-\$270, which confirms that the majority of these borrowers are likely cash constrained as their payday arrives.

Turning to the loans themselves, we see that the average loan was around \$300. The lender charged a per-period interest rate of 18 percent on loans during this time, which generates an average interest charge on these loans of \$54. The average initial loan duration was 13 days for those paid biweekly. If we annualize interest charges of \$50 paid every two weeks for a \$300 loan, this would equate to an approximate annualized interest rate of 433%.¹⁶

¹⁵ Appendix C presents similar analysis for borrowers who are paid semimonthly. The corresponding table for borrowers paid semi-monthly (typically on the 1st and 15th of the month) is in Appendix Table C1.

¹⁶ $\$30 \times 26$ biweekly pay periods in a year = \$1,300 in interest fees. $\$1,300 / \$300 = 4.33$.

4.2 Variation in initial loan durations

In Texas, payday-loan durations are regulated to be “not less than seven days.”¹⁷ This regulation, when combined with the fact that payday loans come due on a borrower’s payday, creates a unique opportunity for us to explore the effect of loan lengths on repayment and rollover behavior because it generates sharp discontinuities in loan lengths depending on when a borrower comes in to initiate a new loan. Because loans cannot have a maturation period of less than seven days, a borrower arriving at a lender six or fewer days before her next payday will receive an extra pay period to repay the loan. For example, a borrower paid biweekly (i.e., every 14 days) who initiates a loan seven days prior to her payday will have a seven-day loan due on her next payday. However, a similar borrower who obtains a loan six days before her next payday will not have to repay the loan on her next payday because that would create a loan shorter than the seven-day minimum. Instead, her loan will be due on her following pay date, implying that she will receive a loan with a 20-day duration.

These effects are illustrated in Figure 3. Because we know when the payday loan is due and the frequency at which a borrower is paid, we can infer the next payday of the borrower for those paid biweekly. We plot on the x-axis the number of days until a borrower’s next inferred (biweekly) payday. The most relevant part of this graph for our empirical design is the difference in maturation periods for borrowers who arrive at the lender six and seven days before their payday. Notice that borrowers arriving seven days before their payday will receive a seven-day loan, but borrowers arriving at the lender six days before their payday will get an extra pay period to repay, receiving a 20-day loan.¹⁸

¹⁷ <http://m.ncsl.org/issues-research/banking/payday-lending-state-statutes.aspx>

¹⁸ In Appendix Figure C1 we show similar discontinuities in loan lengths for borrowers paid semimonthly. In these graphs, we show loan length based on day of the month the borrower initiates the loan. Borrowers paid semimonthly

5. Results

In this section, we report the results of our empirical analysis investigating the effect of having more time to repay an initial payday loan. The goal of our empirical strategy is to exploit the exogenous variation in loan duration generated by binding minimum-loan-length regulations to measure how borrowers will respond in their repayment behavior. To test this effect of having a “grace period,” we will run the following OLS regression:

$$Y_i = \alpha + \beta \text{Grace}_i + \theta X_i + \varepsilon_i \quad (8)$$

where Y_i represents a loan outcome, such as the principal paid on the first due date; Grace_i is an indicator equal to 1 if the individual arrives six days before a loan is due (receives a grace period) and equal to 0 if the individual takes out a loan seven days before their pay date¹⁹; and X_i is a matrix of individual borrower and loan characteristics. Importantly, to assign causality to β , the coefficient on the indicator for receiving a grace-period loan, the decision to come in six days versus seven days before a loan needs to be uncorrelated with other factors that affect the outcome variable. The concern in our setting is that borrowers control when they come in to initiate a loan, and as such borrowers receiving longer loans may be systematically different than those with shorter loans. In Section 5.1 we present evidence suggesting that this type of self-selection bias is likely not present in this setting and argue that as such we can think of the loan lengths around

are typically paid on the 1st and 15th of the month, though some are paid on the 15th and last day of the month. If workers paid semimonthly arrive at the lender on the 8th day of the month, they will typically receive a loan lasting seven days. If, however, they arrive on the 9th day of the month, there are only six days until their next pay date; hence they will instead have 21 days to repay their loan (six days until next payday plus the 15 days of their next pay date). Since there is some variation in exact pay dates (e.g., months when the 15th falls on a Sunday), the observed variation does not exactly match the hypothetical case outlined above. However, there is a clear jump in average loan length between loans originated on the 8th and loans originated on the 9th day of the month. Borrowers obtaining loans on the 8th day of the month have on average 9 days to repay that initial loan, while borrowers on the 9th day have an average of 19 days to repay their loan. Because the number of days in a month varies and some borrowers paid semimonthly get paid at the end of the month rather than the first of the month, the second jump in loan lengths (between the 23rd and 24th of the month) is less precise and therefore we do not use it in the analysis.

¹⁹ For borrowers paid semimonthly, this is equal to one if someone borrows on the 9th day of the month and is equal to 0 if they borrow on the 8th day of the month.

the seven-day regulatory minimum as plausibly exogenous. In Section 5.2 we then present estimates of the effect that different loan lengths have on repayment behavior. Finally, in Section 5.3 we present robustness checks for these estimates.

5.1. Evidence of similarity of borrowers around loan-length discontinuities

The primary endogeneity concern for this paper is that borrowers may understand that by waiting an additional day to obtain a loan they can get much longer initial loan durations. If many borrowers take advantage of that opportunity, we would expect systematic differences in the density and characteristics of borrowers on either side of the discontinuity.

Figure 4 plots the number of loans disbursed by days until payday for borrowers paid biweekly. The solid line in the graph plots the number of loans for borrowers from Texas, which comprise our sample. This graph suggests that there may not be very serious distortion based on borrowers' timing of obtaining a loan as there is little difference between the number of loans given to those with biweekly paychecks seven days before versus six days before their pay date. There is certainly no spike in lending six days before the cutoff, as we would expect if borrowers were strategic about the lending rules.^{20 21}

To further confirm that the pattern of loan disbursements around the seven-day-loan threshold shows little evidence of borrowers responding to the potential for longer loan lengths, we compare the volume of loans initiated by days until paid for borrowers paid biweekly in Texas (our main sample represented by the solid line) versus those residing in Missouri (not in our sample but borrowing from the same institution) in Figure 4. In Missouri, the minimum loan duration during this period was 14, which means there was no discontinuity in loan lengths for initiations

²⁰ The drops in loan volume seen in the figure at 5 days and 12 days prior to payday reflect the fact that the majority of biweekly borrowers are paid on Fridays and payday loan outlets are closed on Sunday.

²¹ Similarly, in Appendix Figure C2, there is no discontinuity in loan volume around the 8th and 9th day of the month for borrowers paid semimonthly.

between six and seven days before payday for Missouri borrowers. The total volume of loans made by this lender in Missouri is much lower than for Texas, so we present the graph using two separate y-axis scales. One can clearly see, however, that despite the very different loan-length environments in the two states, the patterns of loan initiations are very similar. In particular, there is no spike in the number of loans made in Texas six days prior to payday relative to what we see for Missouri.

Our analysis of the characteristics of borrowers receiving longer and shorter loans also suggests that there is nothing unusual about borrowers receiving longer loans that would lead to a bias in our estimates. Figure 5 shows how important characteristics of borrowers vary as a function of how many days before payday the loan was initiated. (Appendix Figure C3 is analogous for semi-monthly borrowers.). We see that patterns of average subprime credit scores, loan sizes, annual net pay magnitudes, and checking account balances are very similar and smooth across the discontinuity that generates the grace period in loan length. We plot a simple third-order polynomial function of the x-axis and its confidence interval allowing for a jump at the loan-length discontinuity point. In virtually every case the function estimates no discontinuity.²²

In Table 2 we show regression results to quantify the magnitude of differences between these characteristics for borrowers who initiate loans either the day before or the day after the “grace-period” cutoff. For this analysis we limit the sample to only borrowers on either side of the cutoff, although we note that the results are very similar if we instead use the polynomial structure from Figure 5 and include all of the data in the regressions. We run a simple OLS

²² For the semimonthly borrowers (Appendix Figure C3), smaller sample sizes lead to more noise, and we see one case (annual net pay) where a fifth order polynomial fits the data well and appears to estimate some discontinuity at the 8th to 9th day of the month. This graph would suggest that borrowers with semimonthly pay periods who get grace periods (i.e., those arriving on the 9th day of month) tend to have slightly higher (~2%) incomes than those who come in a day before.

regression of loan or borrower characteristics on $Grace_i$ from Equation 8.²³ In addition to the four variables we showed in Figure 5, we also test the correlation with the likelihood of signing up for direct deposit, age, gender, race, and home ownership. In all cases we see very little difference in the characteristics of borrowers on either side of the cutoff. The differences are both statistically insignificant in most cases and also have point estimates that are typically around 1% of the mean of the variable of interest.²⁴

Of course, this analysis cannot guarantee that there are not differences between borrowers who come in before and after the grace-period cutoff on unobservable dimensions. However, it is important to note that for unobservable differences to impact our analysis, any such variation would have to be uncorrelated with these observable characteristics, each of which are important predictors of payday loan repayment behavior and generally strong indicators of financial health. The assumption we make going forward in the analysis is that borrowers who receive loans right after the loan-length discontinuity point are otherwise similar to those who receive loans right before the discontinuity and that these differences in loan lengths are plausibly exogenous. This assumption is consistent with the data patterns reported in this subsection and is also plausible given our understanding of payday-borrower behavior. In particular, there is little reason to expect that most payday loan borrowers are familiar with and sophisticated about the regulations of payday loans. Furthermore, the main mechanism we have in mind is that borrowers who are paid on Fridays come in to initiate a loan the weekend in between paychecks and that whether they make it to the lender on Friday evening or Saturday morning is likely driven by a range of

²³ We cluster the regressions at the individual level to account for the fact that some individuals initiate more than one new loan spell during our data timeframe.

²⁴ The variables for age, gender, race, and home ownership status are not available for the full sample, which is why the counts for columns 6 through 9 are lower in Table 2. There is no difference in the probability of having this additional information between borrowers with longer and shorter loans.

idiosyncratic constraints in their daily lives. In Section 5.3, we discuss some additional robustness tests to confirm that our results are not driven by potential selection into loan lengths.

5.2 The effect of a longer initial loan duration on repayment patterns

In Figure 6, we present graphs of our main repayment outcome measures as a function of the days until payday for borrowers paid biweekly. The key finding is that the principal paid on the 1st due date is almost exactly the same for those receiving a grace period as for similar borrowers whose initial loan is due after only seven days, and hence did not get a grace period (6a). We similarly see that receiving a grace period results in no reduction in the likelihood of rolling over at least some of the initial loan balance after the first due date (6b). There are, however, modest reductions in the number of total rollovers (6c) and the total finance charges (6d) paid by borrowers receiving the grace period.

Table 3 Panel A presents regression results to quantify these differences in outcome measures (Equation 8) while restricting the sample to borrowers who initiated loans on either side of the grace-period cutoff.²⁵ These regressions include controls for the borrower and loan characteristics we examined in the previous subsection. In Appendix Table C4, we show that the estimates are not sensitive to the inclusion of control variables.

We estimate that borrowers with biweekly pay cycles who got an additional pay period to repay their initial loan paid down no more than those with shorter loan periods. The point estimate is actually negative, showing that on average borrowers with grace periods paid down \$3.55 less of their principal at the first due date (Col. 1, Panel A). That small difference is not statistically significant and more importantly, we can rule out increases in payments of more than

²⁵ In Appendix Table C4, we also include results with all borrowers paid biweekly and semimonthly, not just those paid on either side of the cutoff. In those regressions, we include a 3rd-order polynomial in days-before-payday for those paid biweekly and a 5th-order polynomial in day-of-the-month for those paid semimonthly.

\$2.57 (or 3% of the mean principal payment at first due date) at the 95% confidence level. Column 2 shows that borrowers are not substantially less likely to roll over a loan at their first due date (1 percentage point for borrowers paid biweekly, which represents 1.6% of the mean).

Consistent with the visual patterns in Figure 6, we document modest reductions in total numbers of rollovers (Col. 3) and total finance charges (Col. 4) paid during the loan spell for borrowers getting grace periods. The reductions are around 10% for both measures. These findings suggest that while the initial impact of the grace period is quite small, there is at least a modest cumulative effect of increasing repayment tempo over the course of the loan spell. The findings are similar for those with semimonthly pay cycles in Appendix Table C3 when we compare those with grace periods (who initiated the loan on the 9th day of the month) to those who initiated the loan a day earlier.

Figure 7a gives perhaps the clearest sense of the overall impact of a grace period on repayment patterns by graphing the average fraction of the initial loan balance that has been repaid by days since origination. This figure is the empirical analogue to the model predictions in Figure 2. Consistent with the predictions for present-biased borrowers (Figure 2b) we see that borrowers who receive grace periods have debt-repayment cycles that are very close to simply a two-week shifting out in the repayment patterns we see for the borrowers with non-grace period loan-repayment terms.

Finally, Figure 7b also shows the evolution of default patterns for borrowers with and without grace periods. The results are consistent with the patterns predicted by the simple model of non-strategic default due to surprise shocks outlined in Appendix B and briefly discussed at the end of Section 3. Grace period borrowers have a lower average fraction of balances defaulted following the second pay period after loan initiation, but eventually have slightly higher default balances. We estimate that after the second pay period (day 21), grace-period borrowers have

defaulted on 1 percentage point, or 11%, (p -value <0.01) fewer loans but across their entire loan spell default on 3 percentage points, or 15% more loans (p -value = 0.01). These patterns are consistent with the model predictions due to the fact that grace-period borrowers remain indebted longer and hence have more opportunity to suffer a shock that will result in a default. One might worry, though, that the higher eventual default rate for grace-period borrowers could signal some unobserved selection difference into grace-period loans. However, that type of selection cannot explain why grace-period borrowers are less likely to default through the first few pay periods after loan origination.

5.3 Robustness checks

We perform a number of robustness checks to determine whether borrowers could be learning about the differential loan durations or whether lenders are pushing borrowers into arriving on different days of the month. Both forms of manipulation in loan length could affect our results.

In our analysis, we assume that borrowers are not strategic about the day that they arrive at the lender; rather, they take out a loan in response to an immediate need or when it is convenient. This assumption implies borrowers who have an initial shorter loan would not have subsequent borrowing habits that were different than borrowers with initial longer loans. If we observe borrowers who take out a loan six days before their next payday take out their next new loan later or earlier than borrowers who take out a loan seven days before their next payday, one would worry that borrowers are selecting into the day that they take out a loan during their next loan cycle. We find that borrowers paid biweekly and whose first loan is seven days before their payday, on average, take out their next new loan 8.09 days before their next payday. Borrowers who take out a loan six days before their next payday take out their next new loan 7.91 days before

they are paid, a difference of only 0.18 days. Meanwhile, borrowers paid semimonthly who take out their first payday loan on the 8th day of the month, on average, take out their next new loan on the 15th (15.22) while borrowers paid semimonthly who take out their first payday loan on the 9th day of the month, come in on the 15th (14.68) day of the month, as well. Given these facts, it does not appear that borrowers are learning or sophisticated on this front: Borrowers who have an initial shorter loan have similar subsequent borrowing habits as borrowers with initial longer loans.

In Table 3 Panel B, we run the main regressions for borrowers paid biweekly, restricting the sample to the first loan the borrower obtained from this payday lender. By focusing on the borrower's first observed interaction with the lender, we reduce the likelihood that borrowers are selecting into either the sixth or the seventh day before their next payday as they learn more about how the payday loan process works.²⁶ As the table shows, the results are very similar to our main results: borrowers with more time pay only slightly less on their principal at the first due date, are only slightly less likely to roll over a loan, have modestly fewer total rollovers and thus pay less in total finance charges.

Finally, we might worry that lenders are influencing who gets loans based upon the day of the month or the number of days until the potential borrower's next paycheck. Recall that lenders charge a fixed fee independent of the length of the loan, so underwriting shorter loans may be more desirable. If lenders would rather give out shorter loans, then we might expect the approval rating for loans to be lower for borrowers who are facing a longer loan length, encouraging borrowers to take out a loan on a different date. We can observe whether borrowers are approved or denied a loan based on a subprime credit score and their pay frequency (biweekly, semimonthly,

²⁶ We note, however, that we only observe the first interaction with this lender, not *any* lender. Our sample period was a time of rapid expansion of payday lending, so it is likely that the first observation we have for many (but not all) borrowers is their first interaction with any payday lender.

monthly, or weekly). We do not observe when a borrower's next payday is if she does not take out a loan, so we restrict our analysis to borrowers paid semimonthly for whom we can easily infer pay dates. For the days that we are interested in, the 8th and the 9th day of the month, the approval rating is between 95.3 and 97.2 percent, respectively. While the approval rating does vary by 1.9 percentage points, the direction of the difference is the opposite sign we would expect if the lender was trying to influence borrowers into shorter loans. Borrowers actually have, on average, a slightly *higher* probability of getting approved if they come in on the 9th of the month (receiving a longer loan length) relative to coming in on the 8th day of the month.

6. Discussion of Model Robustness

The empirical patterns documented in the prior section correspond well with the predictions of naïve present-biased individuals' repayment patterns from our simple baseline model in Section 3. However, that coherence with the model does not rule out that other economic considerations could also rationalize these patterns. In this section, we discuss other economic forces that could potentially deliver the main repayment patterns without naïve present bias.

In Appendix D, we explore how the model predictions change if we allow for the possibility that whatever shock led to the initial borrowing has some degree of consumption “hangover” so that the marginal utility of consumption is higher right after the loan is initiated and falls over time. We model this simply by allowing for a lower level of income available during the first pay cycle. We think of this as capturing the fact that the initial payday loan was not large enough to cover the entire expenditure/income shock that required borrowing and therefore a part of the income in the first pay cycle must be devoted to covering the lingering shock. Allowing for this possibility does not help explain the empirical repayment patterns. Lower available income

in the first pay period reduces the amount borrowers repay at the first due date, but it does so for non-grace period borrowers as well as grace period borrowers. That is, a consumption-shock hangover of this type can help explain why a person would not use the grace period to save, but in that case it would also imply that the same person who does not have a grace period would not make a repayment either.

In Appendix E, we study the effects of an anticipated one-time future income increase on repayment in a version of our model without present bias. We begin by introducing an expected income increase at a future date. The increases are measured in fractions of the regular bi-weekly income $y=900$. Accounting for borrower heterogeneity, we assume that different groups in the population get varying levels of income increases at different future dates. Model predictions on aggregate repayment patterns is then computed as a weighted average of individual repayment patterns in different groups. As shown in Figure E2, an anticipated one-time future income increase is able to generate a delay of repayment schedule in the grace period case. This is because the anticipated future income increase introduces a wealth effect which makes the agents scale up consumption for the periods before the income increase is realized. This increase in consumption has two effects: first it decreases repayments for periods before the income increase is realized in both non-grace period and grace period cases; second, it decreases savings over the grace period in the grace period case. While the first effect applies to both non-grace and grace borrowers, it is the second effect which only applies to the grace period borrowers that pushes off the repayment schedule in the grace case. However, we fail to capture two empirical facts in this experiment. First, the model generated repayment schedule delay of the grace period borrowers disappears after income increases are materialized while the delay is persistent over time in the data. Second, borrowers in the model pay off their debt balances soon after the income increase while we see continuous rollovers of debt empirically. The failure of the model in these two aspects is caused

by the fact that once the income increase is realized, the wealth effect disappears. Since there is no present bias, both type of borrowers optimally choose to pay off their debt after their income increases is materialized. The grace period borrowers “catch up” in repaying right after the income increase arrives and thus eliminate the delay of repayment schedule.

A version of this dynamic that could better rationalize the observed repayment patterns would incorporate individuals continually (but erroneously) believing that they were going to receive a positive income shock in the near future. The expectations of a future income rise would help explain the “wasting” of grace periods. The fact that the extra income never actually materializes (coupled with consumers naively holding out hope for it) would explain how that dynamic persists across many pay periods. That type of naïve belief is ultimately quite close to the patterns generated by our model of naïve present bias in Section 3.

7. Conclusion

This paper documents that payday-loan borrowers receiving a grace period take only modest advantage of the additional time before repayment to engage in saving to help repay the loan. These patterns are difficult to reconcile with anticipated consumption-smoothing behavior for forward-looking exponential discounters but are in line with expectations from the model incorporating modest levels of naïve present-bias.

These findings have implications for policy makers who are interested in improving subprime credit markets. For example, our results suggest that having more time to repay a loan will not, by itself, necessarily improve repayment behavior or result in smoother consumption profiles. More time is not necessarily beneficial for myopic consumers, who may instead need commitment technologies that help ensure more steady consumption streams. More generally, this paper provides some new evidence that consumer myopia is an important factor for payday

loan borrowers. When coupled with other evidence pointing in similar directions, such as Bertrand and Morse (2011), this highlights the value of incorporating an awareness of consumer myopia into regulation of these lending products more broadly.

The results also suggest that there may be important dynamics in how present-biased people respond to information about predictable future income and expenditure changes related to how far in the future those events are. Prior research on consumption dynamics in the quasi-hyperbolic model shows that predictable changes in income or credit conditions can lead to corresponding consumption changes for present-biased individuals that would be smoothed out more fully by time consistent agents (e.g Angeletos et al., 2001; Laibson, 1997; Stephens and Unamaya, 2011, Gross and Tobacman, 2014). In our setting we document a new and related empirical pattern: a lack of response to the length of time to prepare for a future expenditure. The broader literature on consumption dynamics incorporating time inconsistency has not yet systematically explored questions related to the timing of when people are aware of future shocks and how consumption responses relate to that timing. Considering these issues more fully might be valuable for our understanding of a range of different consumer credit products. For example, adjustable-rate mortgages, credit cards, and student loans all often have initial periods of low introductory interest rates followed by higher interest rates or balloon payments. Exploring how the length of these introductory periods interacts with consumer myopia could be a useful direction for future research.

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Figure 1: Model Predictions for Repayment and Total Interest as Present Bias Increases

Figure 1a: Size of 1st Repayment

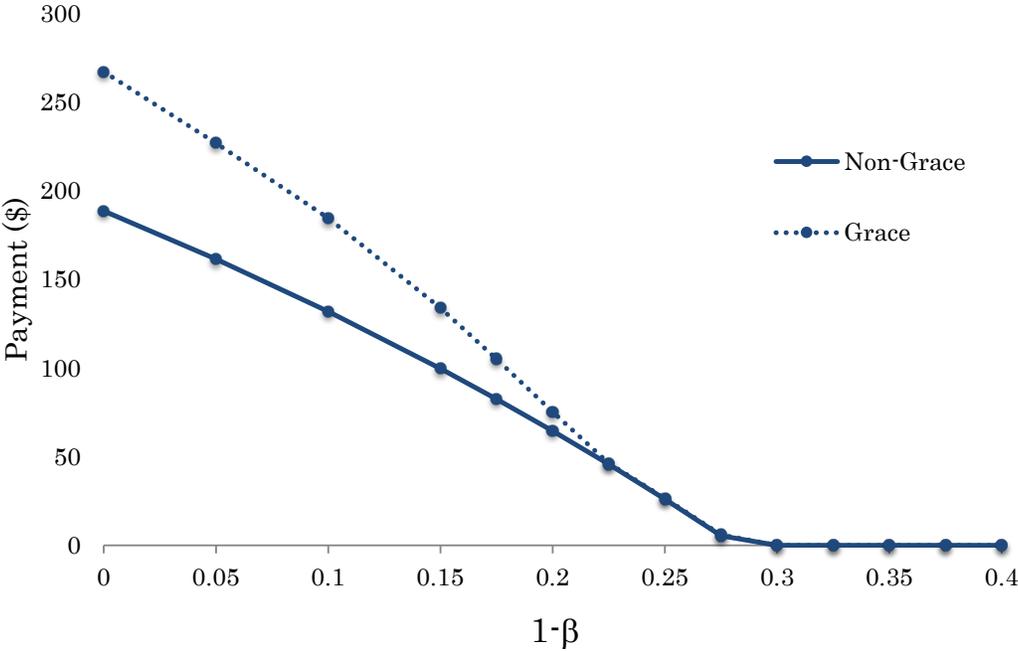
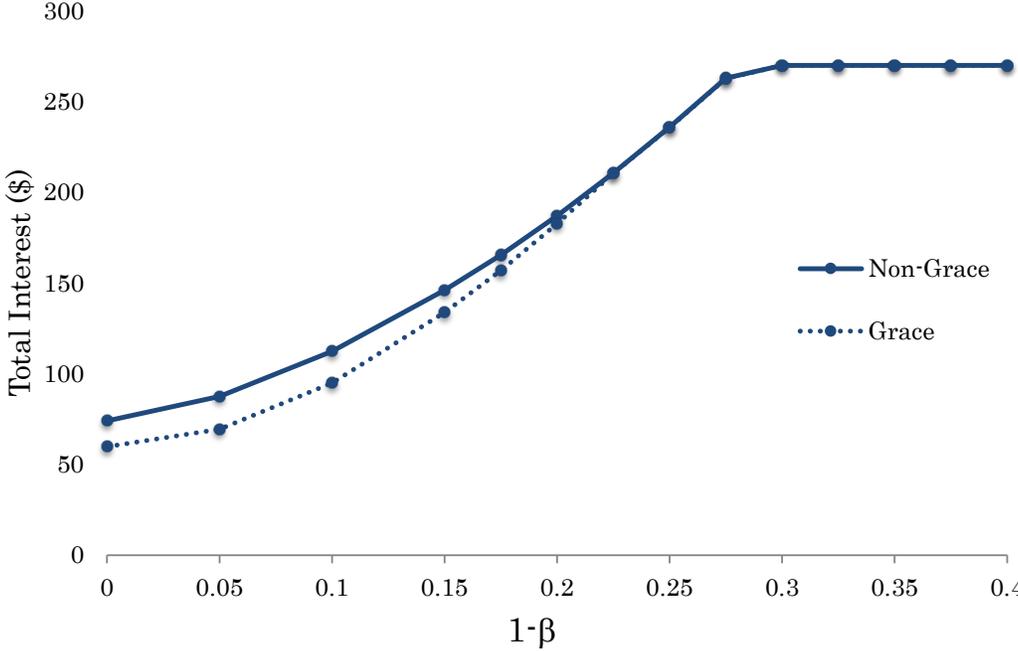


Figure 1b: Interest Paid through 1st Five Due Dates



Notes: The figures represent model predictions for size of first repayment and total interest paid under varying degrees of present bias. $1-\beta = 0$ represents no present bias. Present bias increases with decreases in β . In both figures, $\delta_y = 0.8$, the initial loan amount (D_0) is \$300, and the intertemporal elasticity of substitution is 1 (log utility).

Figure 2: Model Predictions for Fraction of Debt Repayment with and without Present Bias

Figure 2a: Fraction of Initial Debt Repayment with no Present Bias ($\beta=1.0$)

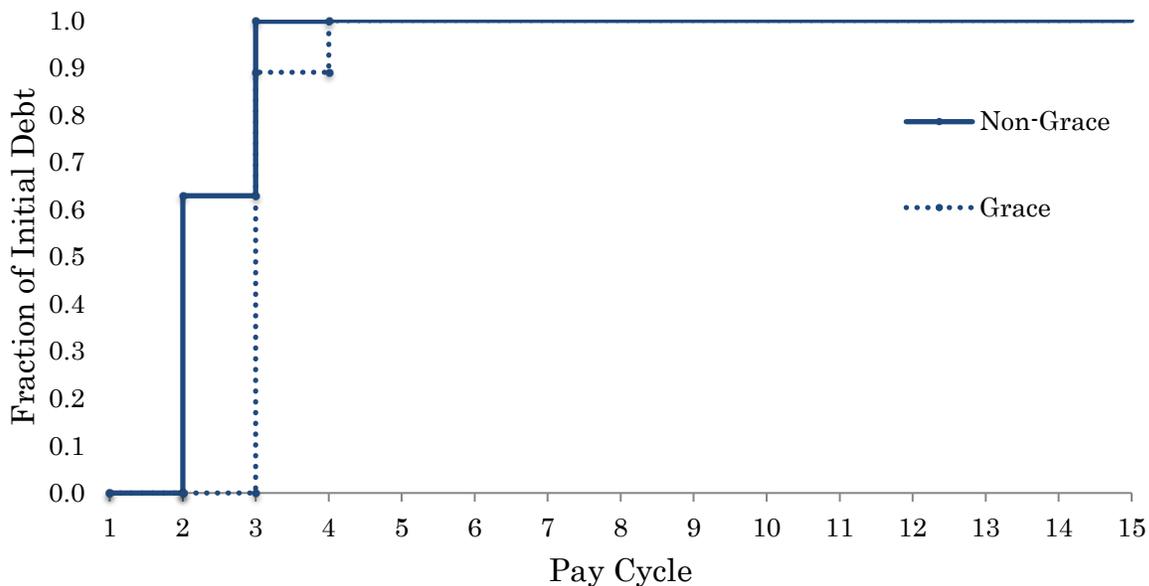
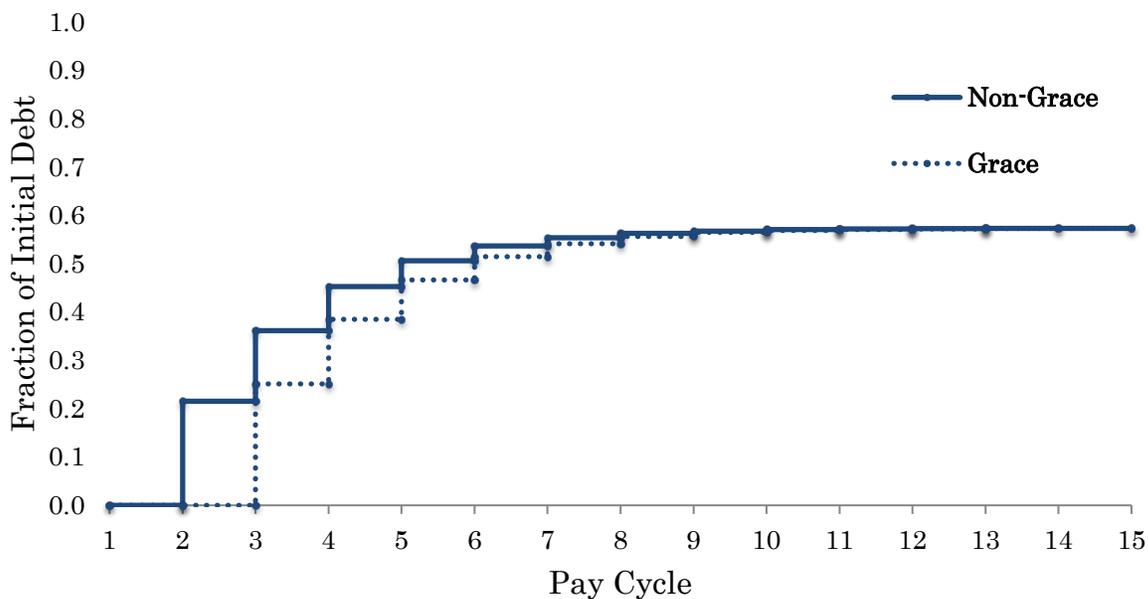
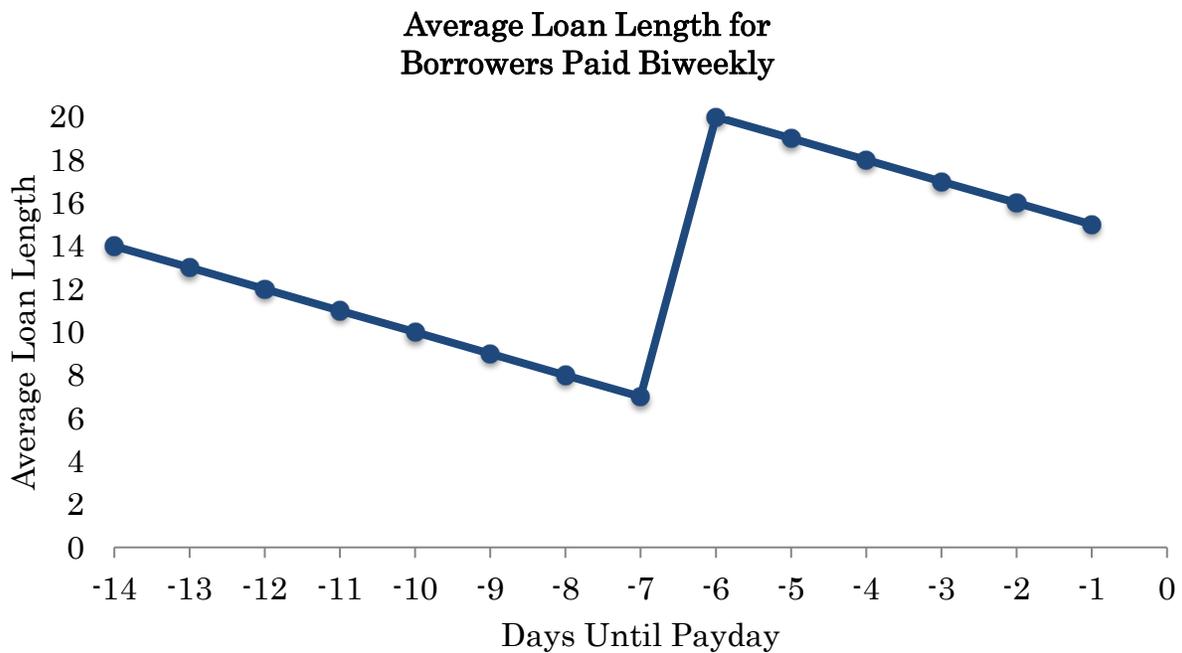


Figure 2b: Fraction of Initial Debt Repayment with Present Bias ($\beta=0.8$)



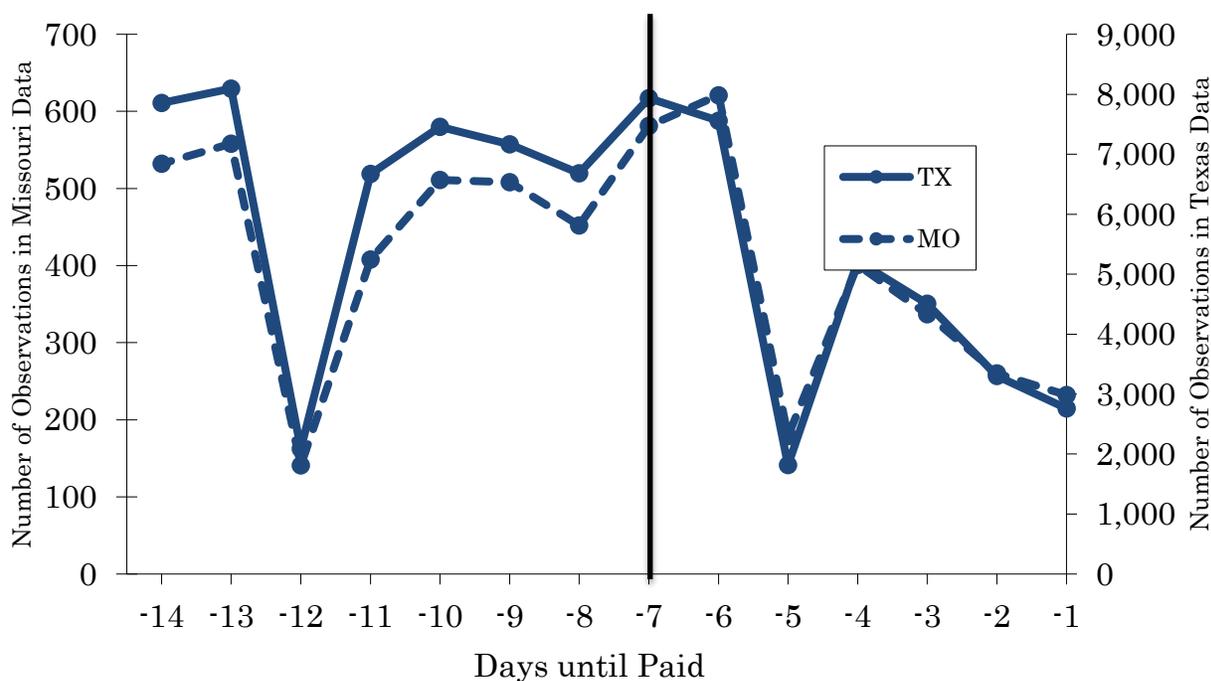
Notes: The figures represent model predictions for the fraction of initial loan repaid at each pay cycle. Figure 2a assumes $\beta = 1$ and represents no present bias. Figure 2b assumes $\beta = 0.8$ and presents some level of present bias. In both figures, $\delta_y = 0.8$, the initial loan amount (D_0) is \$300, and the intertemporal elasticity of substitution is 1 (log utility).

Figure 3: Loan Length



Notes: Authors' calculations based on payday loan transaction data in Texas from November 2001 until August 2004. Figure 3 reports the average loan length for borrowers paid biweekly. The minimum amount of time a borrower can take out a loan is seven days. If a borrower arrives at the lender with fewer than seven days until her next payday, the loan length is equal to the number of days until that payday plus the time until the next loan (14 days for biweekly borrowers). *Days until Payday* is created to be equal to the loan length if the loan length was less than 14 *Days until Payday* is equal to the loan length minus 14 if the loan length was greater than 14.

Figure 4: Borrowers Paid Biweekly in Texas versus Missouri



Notes: Authors' calculations based on payday loan transaction data in Texas and MO from November 2001 until August 2004. The figure reports the number of observations for borrowers paid biweekly in Texas and Missouri, respectively, for each day. The vertical line represents seven days before a payday loan is due. If someone comes in one day later (six days before their pay day), they receive an additional 14 days. See Figure 3 for details on creation of days until payday for borrowers paid biweekly.

Figure 5: Graphs for Key Control Variables for Borrowers Paid Biweekly

Figure 5a: Credit Score

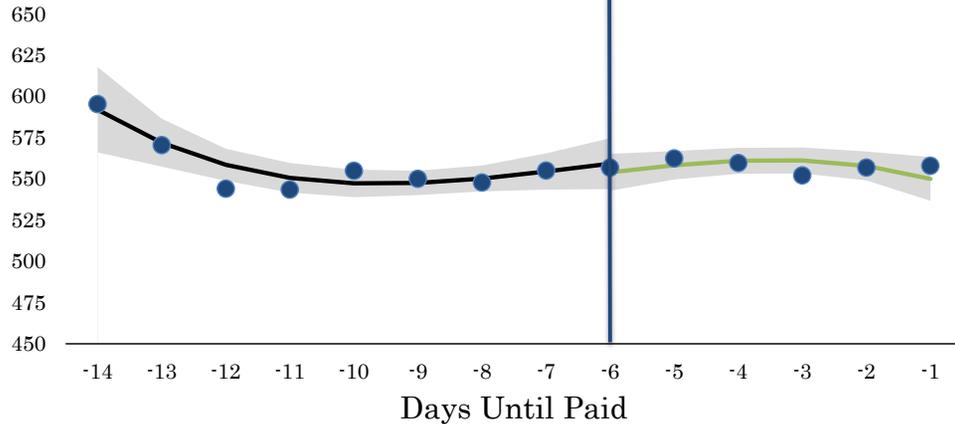


Figure 5b: Loan Size (\$)

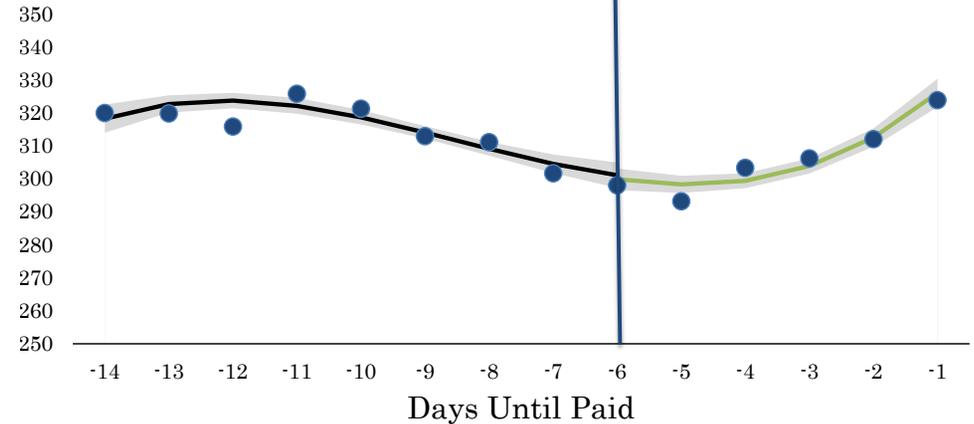


Figure 5c: Annual Net Pay (\$)

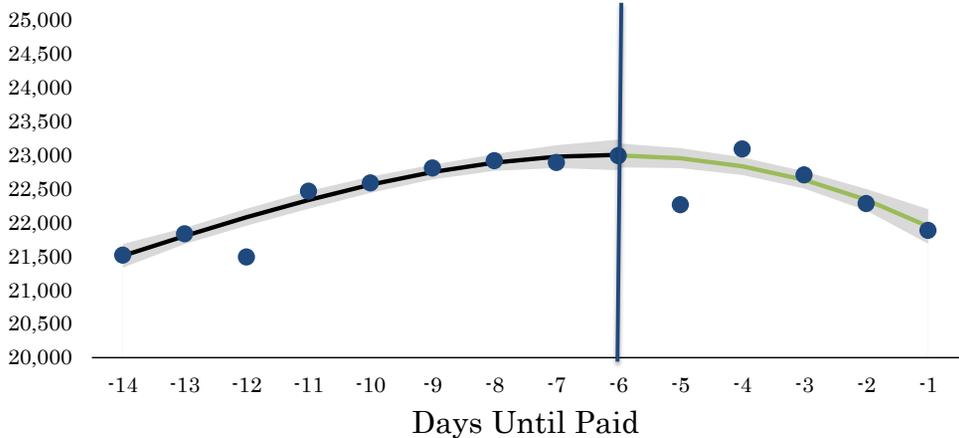
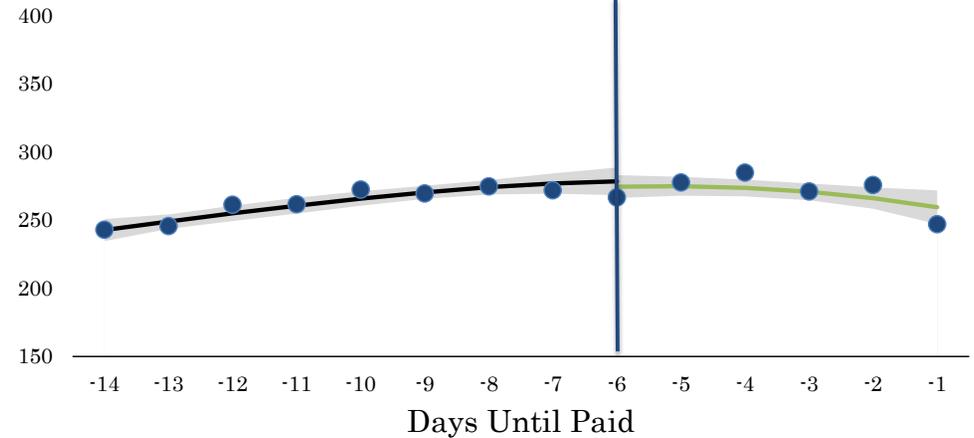


Figure 5d: Checking Account Balance (\$)



Notes: Authors' calculations based on payday loan transaction data in Texas from November 2001 until August 2004. The vertical line marks six days until payday, i.e., the day in the pay cycle where the borrower experiences a discontinuous increase in loan length. Dots on the graph represent the averages of each outcome (in the figure heading) for each day until payday. The curve shows the predicted outcomes from the regression results of the outcome variable on the cubic form of days until payday as well as an indicator for a borrower taking out a loan six or fewer days before their next payday. The curve to the left of the line is the predicted outcome without an indicator for six or fewer days until payday. The curve to the right of the line maps the predicted outcomes including the dummy for less than six days until payday. 95% confidence intervals are included in gray.

Figure 6: Outcomes for Borrowers Paid Biweekly

Figure 6a: Principal paid on first due date

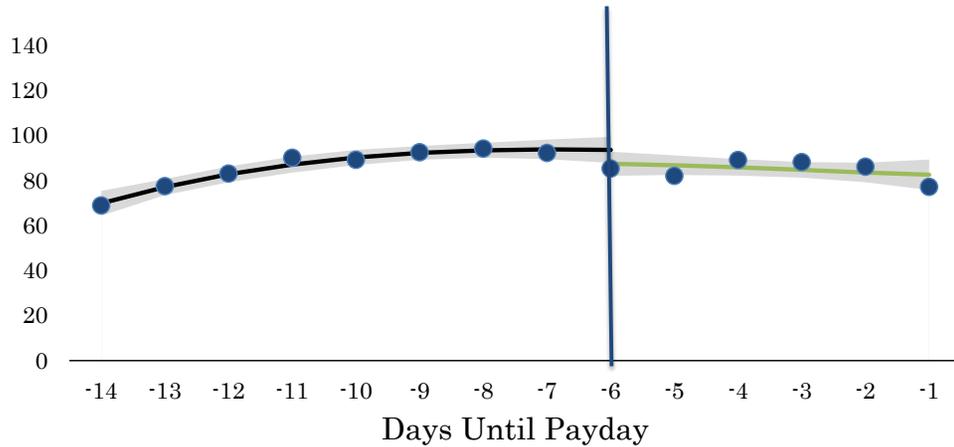


Figure 6b: Rolled over some of the loan at the first due date

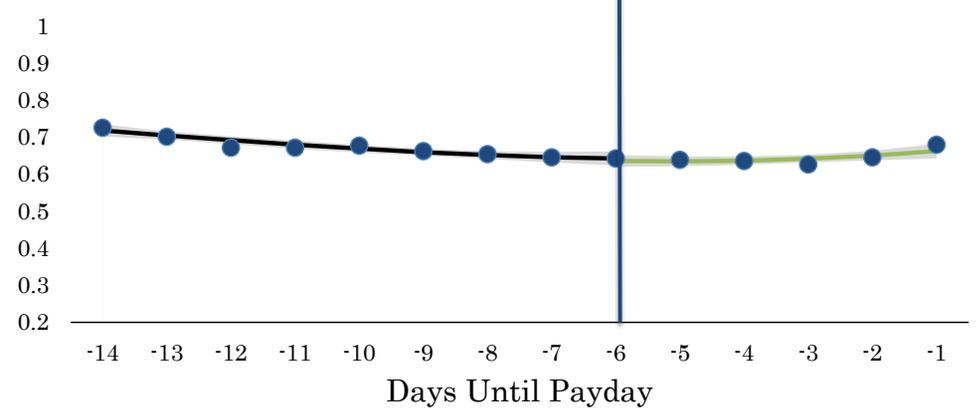


Figure 6c: Number of effective rollovers in loan spell

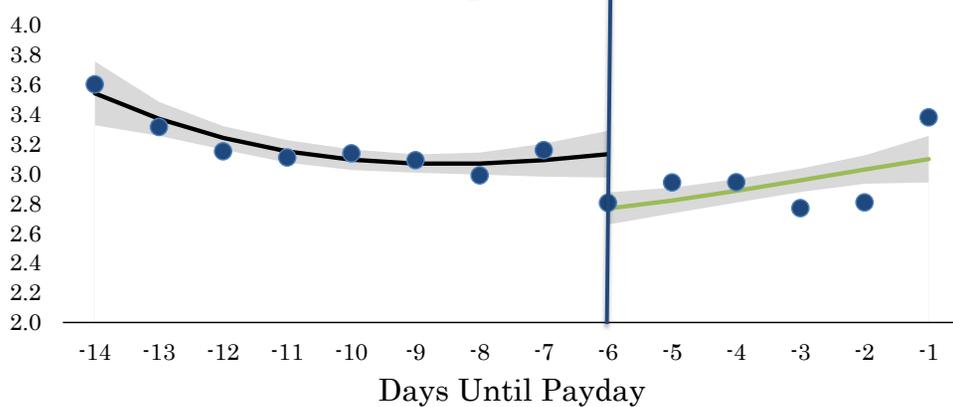
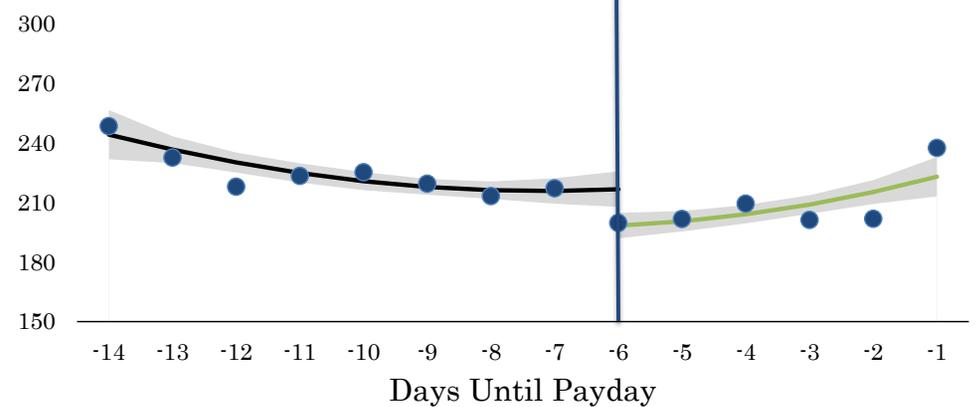


Figure 6d: Total finance charges paid in loan spell



Notes: Authors' calculations based on payday loan transaction data in Texas from November 2001 until August 2004. The vertical line marks six days until payday, i.e., the day in the pay cycle where the borrower experiences a discontinuous increase in loan length. Dots on the graph represent the averages of each outcome (in the figure heading) for each day until payday. The curve shows the predicted outcomes from the regression results of the outcome variable on the cubic form of days until payday as well as an indicator for a borrower taking out a loan six or fewer days before their next payday. The curve to the left of the line is the predicted outcome without an indicator for six or fewer days until payday. The curve to the right of the line maps the predicted outcomes including the dummy for less than six days until payday. 95% confidence intervals are included in gray.

Figure 7: Debt Repayment and Default Over Time

Figure 7a: Average Fraction of Initial Debt Repaid

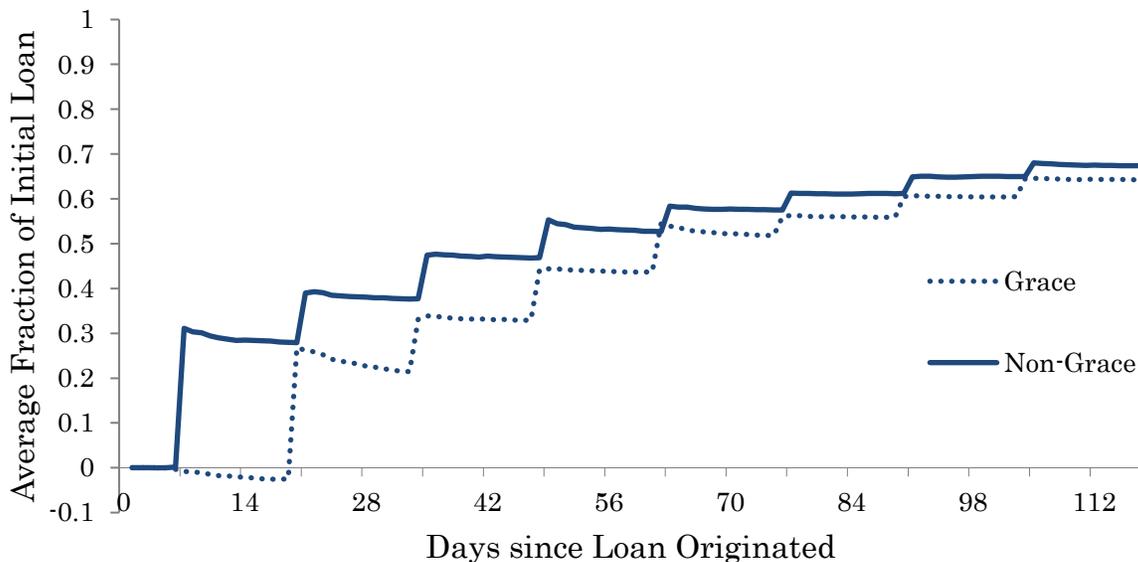
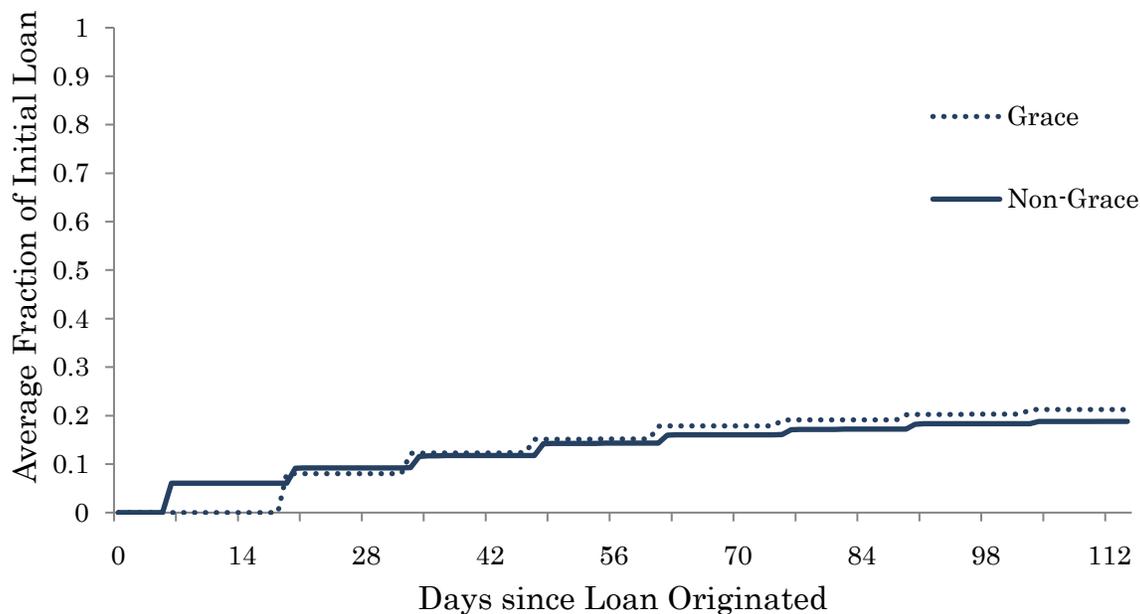


Figure 7b: Average Fraction of Initial Debt Defaulted



Notes: Authors' calculations based on payday loan transaction data in Texas from November 2001 until August 2004. Figure 7a shows the average fraction of initial debt repaid by days since loan originated. Figure 7b shows the average fraction of initial debt defaulted on by days since loan started. We separate borrowers by the discontinuity in loan lengths. We show borrowers who arrive seven days before their payday and get a seven day loan ("Non-Grace") and borrowers who arrive six days before their payday and therefore receive a 20-day loan ("Grace").

Table 1: Summary Statistics

	(1)	(2)
	Biweekly Sample	Biweekly Sample (Restricted to 6 and 7 days before payday)
Borrower Characteristics for Initial Loans		
Age	36.19 (10.00)	36.19 (9.99)
Female	64.85%	63.35%
White	21.83%	21.75%
Black	40.78%	40.68%
Hispanic	36.35%	36.63%
Race, other	1.05%	0.95%
Fraction homeowners	37.26%	37.72%
Direct deposit	75.92%	77.51%
Annualized net pay (\$)	22,476.67 (8,922.01)	22,940.35 (8,958.25)
Checking balance (\$)	265.04 (423.39)	269.39 (422.72)
Credit Score	558.97 (210.77)	555.94 (208.92)
Initial Loan Characteristics		
Principal of Initial Loan (\$)	312.48 (133.41)	299.93 (134.78)
Interest Due on Initial Loan (\$)	56.25 (24.01)	53.99 (24.26)
Initial Loan length (days)	12.79 (4.13)	13.34 (6.50)
Initial Loan Outcomes		
Principal paid on first loan	85.74 (150.57)	88.84 (152.54)
Rolled over some of the loan at first due date	0.67	0.64
Number of Effective Rollovers in Loan Spell	3.11 (4.70)	2.98 (4.71)
Total Finance Charges Paid in Loan Spell	219.69 (306.92)	208.55 (303.90)
Loan Spell Ended with Default	0.22	0.20
Total Number of Initial Loans	79,098	15,491
Total Number of Loans (including Rollovers)	325,020	61,709

Notes: Averages of all variables shown, with standard deviations in parentheses for continuous variables. Data are based on authors' calculations from administrative data from a large payday lender in Texas from 2000-2004. Initial loans are loans where the borrower did not have a loan outstanding for at least 32 days prior to initiation. Our administrative records do not include demographic information for all borrowers, and we have gender, race, and home ownership information for around 50% of the sample.

Table 2: Control Variables as Outcomes for Borrowers Paid Biweekly

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Subprime Credit Score	Loan Amount	Net Pay	Account Balance	Direct Deposit	Age	Female	Black / Hispanic	Home Owner
	Sample Restricted to Origination Date Six and Seven Days until Payday								
Mean	555.94	299.93	22,940.35	269.39	0.78	36.19	0.63	0.77	0.38
Grace (Six Days until Payday)	1.79 (3.41)	-3.62* (2.18)	103.21 (147.25)	-5.34 (6.87)	-0.003 (0.01)	0.28* (0.16)	0.02 (0.01)	0.01 (0.01)	-0.01 (0.01)
N	15,491	15,491	15,491	15,491	15,491	15,480	7,396	7,358	8,072

Notes: Data are based on authors' calculations from administrative data from a large payday lender. OLS regressions shown for subprime credit score, loan amount, net pay, account balance, direct deposit indicator, age, female indicator, black or hispanic indicator, and homeowner indicator. The sample is restricted to borrowers paid biweekly who have an origination date six or seven days before their payday. The sample includes individuals who are missing information on age, gender, race, and home ownership, which is reflected in the changing number of observations in columns six through nine. Standard errors are clustered at the individual level and are reported in parentheses below the coefficients. ***, **, and * designates statistical significance at the 1%, 5%, and 10% level, respectively.

Table 3: Regression Results

	(1)	(2)	(3)	(4)
	Principal paid on first due date	Rolled over some of the loan at first due date	Number of Effective Rollovers in Loan Spell	Total Finance Charges Paid in Loan Spell
Panel A: Biweekly Sample Restricted to Origination Date Six and Seven Days until Payday				
Mean	88.84	0.64	2.98	208.55
Grace (Six Days until Payday)	-3.55 (3.12)	-0.01 (0.01)	-0.34*** (0.09)	-16.34*** (5.23)
Other Controls?	Yes	Yes	Yes	Yes
N	15,491	15,491	14,073	14,073
R ²	0.11	0.05	0.03	0.06
Panel B: First Observations of Biweekly Sample				
Mean	79.02	0.66	3.14	218.72
Grace (Six Days until Payday)	-1.54 (4.53)	-0.02 (0.01)	-0.37*** (0.12)	-19.30** (7.99)
Other Controls?	Yes	Yes	Yes	Yes
N	6,778	6,778	6,019	6,019
R ²	0.13	0.06	0.03	0.07

Notes: Data are based on authors' calculations from administrative data from a large payday lender. OLS regressions shown for four outcomes: Principal Paid on first due date calculates the amount of the loan paid by the first due date; Rolled over some of the loan at first due date indicates that the borrower rolled over the loan at the first due date; Number of Effective Rollovers is a variable that counts the number of additional loans in succession by a borrower; and Total Finance is the total finance charged over the loan cycle. Panel A restricts the sample to borrowers paid biweekly who have an origination date six or seven days before their payday. Panel B includes the sample in Panel A but only uses the first observation for each borrower. Controls in all columns include loan size, gender, net pay per year, checking account balance, subprime credit score, and age bins. Dummies for race (white, black, Hispanic, or other), having loans direct deposited, or missing control variables are also included. Columns 3-4 include fewer observations because we did not include loans initiated with less than 5 pay periods before the end of our sample so as to not artificially truncate these outcomes. Standard errors are clustered at the day the loan was initiated and are reported in parentheses below the coefficients. ***, **, and * designates statistical significance at the 1%, 5%, and 10% level, respectively.

Appendix A: Model Solution Details

We solve the model using recursive methods. To fully characterize optimal decisions of agents in the model, we use a two-step procedure. The first step is to find the solution to a time consistent (i.e. exponential discounting) version of the agent’s dynamics programming problem. The second step is to solve a time inconsistent version of the agent’s problem. The source of time inconsistency in our model is that agents exhibit quasi-hyperbolic discounting. In addition, we assume that the agents are naive as opposed to sophisticated. Thus in the time inconsistent problem, agents incorrectly think that their future selves would behave in a time consistent manner. In the following section, we write out formally the dynamic programming problems of the two-step procedure for the non-grace period case and the grace period case respectively. After that we describe the algorithm used to solve the dynamic programming problems.

Agent’s Problem—Non-Grace Period Case

In the non-grace period case the time consistent problem for a day t agent is the as follows.

$$V(D^I) = \max_{\{\hat{c}_i^I\}_{i=t}^T, \hat{D}^{I+1}} \ln(\hat{c}_i^I) + \sum_{i=t+1}^T \delta^{i-t} \ln(\hat{c}_i^I) + \delta^{T+1-t} V(\hat{D}^{I+1}) \quad (P1)$$

subject to

$$\hat{D}^{I+1} \leq D^0 \quad (S1)$$

$$\sum_{i=1}^T \hat{c}_i^I + rD^I = y - (D^I - \hat{D}^{I+1}) \quad (S2)$$

T is the terminal day of one pay cycle and we set it to 14 to match a bi-weekly payday loan repayment schedule. D^0 denotes the initial level of debt. y is the bi-weekly income. The index for days within a pay cycle is i while I is the index for pay cycles. In addition, δ is the exponential discount factor while β is the quasi-hyperbolic discount factor. We constrain the level of debt to be below the initial level as stated in (S1). The *hat* notation denotes the beliefs for the naive agent, which are always the values for a time consistent agent. The solution of the above problem consists of a value function, $V(D^I)$, and a policy function for next period debt, $f(D^I) = D^{I+1}$. They are both time consistent in the sense that the solutions from different t agents are the same. In other words, the two functions $V(D^I)$ and $f(D^I)$ are not time dependent. Having obtained the solutions of the time consistent problem, the second step is to solve the time inconsistent problem, which is the one we ultimately

focus on in this paper. Note that because agents are assumed to be naive, they incorrectly believe that their future selves would adopt the time consistent behavior. Through the lens of the time consistent model, this means that they think they will follow the time consistent solutions in the future. Formally, we write a day t agent's problem as follows:

$$W(D^I, t) = \max_{c_t^I, \{\hat{c}_i^I\}_{i=t+1}^{14}, \hat{D}^{I+1}} \ln(c_t^I) + \beta \left\{ \sum_{i=t+1}^{14} \delta^{i-t} \ln(\hat{c}_i^I) + \delta^{15-t} V(\hat{D}^{I+1}) \right\} \quad (\text{P2})$$

subject to

$$\hat{D}^{I+1} \leq D^0 \quad (\text{S2})$$

$$\sum_{i=1}^t c_i^I + \sum_{i=t+1}^{14} \hat{c}_i^I + rD^I = y - (D^I - \hat{D}^{I+1}) \quad (\text{S3})$$

Note that consumption before and including today does not have *hat* because these are the actual choices made by the agent. However, consumption beyond today has *hat* due to the naive agent's incorrect beliefs. Given our time convention, the actual level of next cycle's debt, D^{I+1} is determined on day 14. Thus the day 14 agent problem is

$$W(D^I, 14) = \max_{c_{14}^I, D^{I+1}} \ln(c_{14}^I) + \beta \delta V(D^{I+1}) \quad (\text{P2-14})$$

subject to

$$D^{I+1} \leq D^0 \quad (\text{S2-14})$$

$$\sum_{i=1}^{14} c_i^I + rD^I = y - (D^I - D^{I+1}) \quad (\text{S3-14})$$

The solution to the above time inconsistent problem is a set of value functions, $\{W(D^I, t)\}_{t=1}^{14}$, a set of policy function for next period debt $\left\{ \left\{ f(D^I, t) = \hat{D}^{I+1} \right\}_{t=1}^{13} \text{ and } f(D^I, 14) = D^{I+1} \right\}$. One thing worth noting is that due to the naive quasi-hyperbolic discounting the agent revises her expectations each day about the level of debt she will hold next period. Timming is summarized as follows.

- on each day before the 14th day of a pay cycle, an agent makes decisions on her daily consumption and on how much money to leave for tomorrow;
- on the 14th day of a pay cycle, an agent makes decisions on how much to consume for that day and how much to pay down her payday loan principal;

- on the 15th day, an agent receives a new pay check and the next pay cycle begins.

Figure A1 puts the timing convention in perspective.

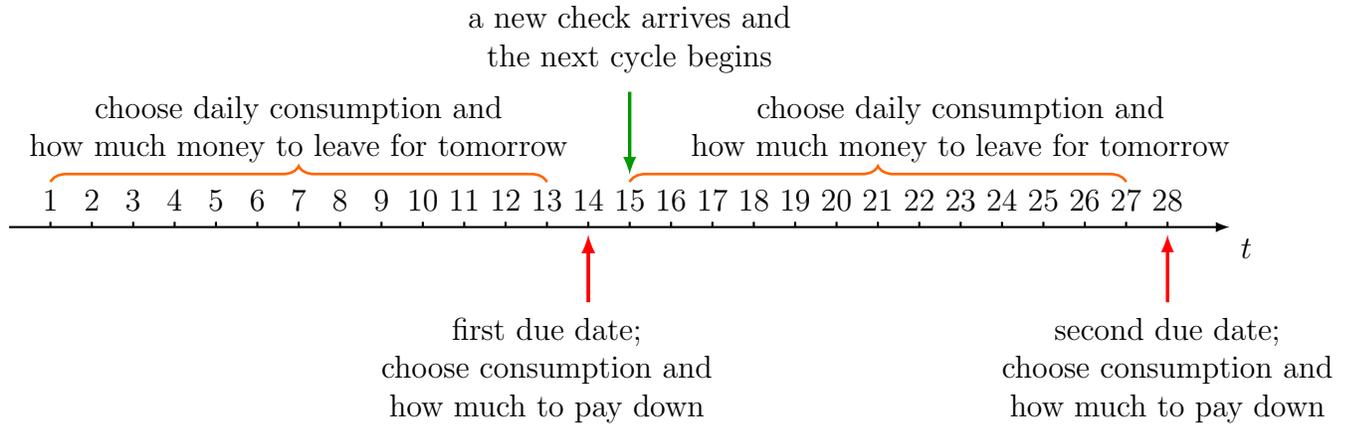


Figure A1: Model Timing—Non-Grace Period Case

Agent’s Problem—Grace Period Case

The grace period case differs from the above non-grace period case in that there is no payment required for the first pay cycle. Figure A2 below puts this difference in perspective by outlining the timing convention of the grace period case.

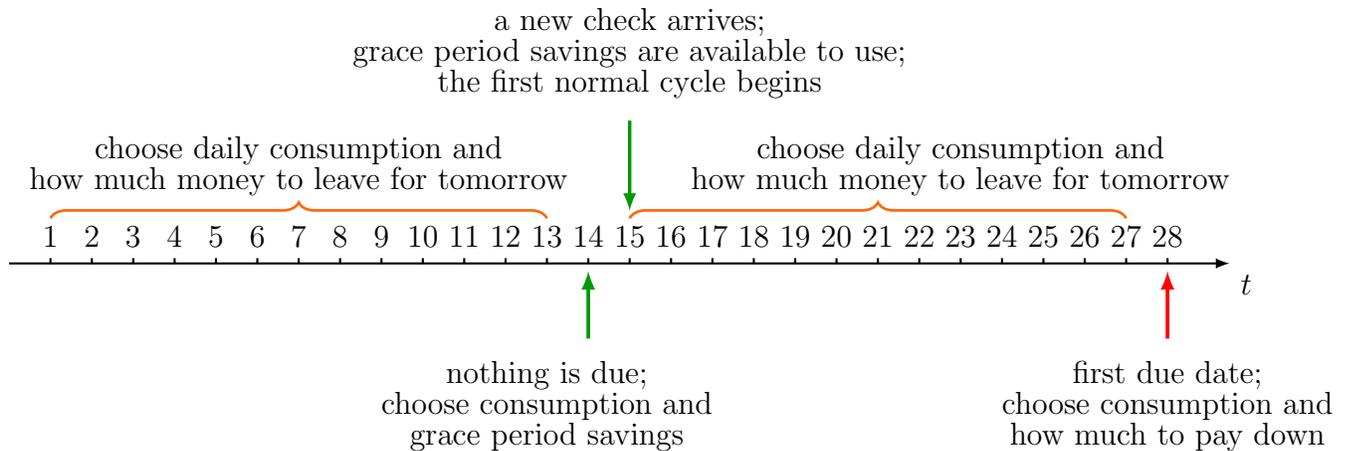


Figure A2: Model Timing—Grace Period Case

To properly reflect this difference in the model, we need to solve two separate Bellman equations for the grace period (i.e. the first 14 days since debt initiation) and the first normal period (i.e. the second 14 days since debt initiation) in addition to the one in the

non-grace period case. Each of the two Bellman equations needs to be solved using a two step procedure that is similar to one in the non-grace period case. Before writing them down formally, we shall describe what the agent's problems are in these two special cycles. During the grace period the agent makes decisions on her daily consumption and grace period saving. Grace period saving is the money saved for next period. Thus during the first normal cycle, the agent's total disposable income is increased by the amount of grace period saving while the decisions she needs to make are the same as in any other normal cycles. Formally, the additional dynamic programs for these two special periods are as follows:

Agent's Problem in the Grace Period

$$W^g(t) = \max_{c_t^g, \{\hat{c}_i^g\}_{i=t+1}^{14}, \hat{G}} \ln(c_t^g) + \beta \left\{ \sum_{i=t+1}^{14} \delta^{i-t} \ln(\hat{c}_i^g) + \delta^{15-t} V^1(D^0, \hat{G}) \right\} \quad (P3)$$

subject to

$$\hat{G} \geq 0 \quad (S5)$$

$$\sum_{i=1}^t c_i^g + \sum_{i=t+1}^{14} \hat{c}_i^g + \hat{G} = y \quad (S6)$$

where G is the level of grace period saving and $V^1(D^0, G)$ is the time consistent value function of the agent in the first normal cycle. We highlight that the actual level of grace period saving is determined on day 14. Hence when $t = 14$, *hat* variables in the above program are replaced with actual values. To obtain the solution to the above problem, we first solve for $V^1(D^0, G)$ in the following way.

$$V^1(D^0, G) = \max_{\{\hat{c}_i^1\}_{i=t}^{14}, \hat{D}^2} \ln(\hat{c}_i^1) + \sum_{i=t+1}^{14} \delta^{i-t} \ln(\hat{c}_i^1) + \delta^{15-t} V(\hat{D}^2) \quad (P4)$$

subject to

$$\hat{D}^2 \leq D^0 \quad (S7)$$

$$\sum_{i=1}^{14} \hat{c}_i^1 + rD^0 = y + G - (D^0 - \hat{D}^2) \quad (S8)$$

where $V(\cdot)$ on the left hand side of the above Bellman equation is the time consistent value function obtained from (P1). Again, due to naive quasi-hyperbolic discounting, the policy functions for consumption and next period debt from (P4) are not the actual values the

agent would choose. To obtain those actual values, we proceed to solve the time inconsistent problem of the first normal cycle as follows.

$$W^1(D^0, G, t) = \max_{c_t^1, \{\hat{c}_i^1\}_{i=t+1}^{14}, \hat{D}^2} \ln(c_t^1) + \beta \left\{ \sum_{i=t+1}^{14} \delta^{i-t} \ln(\hat{c}_i^1) + \delta^{15-t} V(\hat{D}^2) \right\} \quad (P5)$$

subject to

$$\hat{D}^2 \leq D^0 \quad (S9)$$

$$\sum_{i=1}^t c_i^1 + \sum_{i=t+1}^{14} \hat{c}_i^1 + rD^0 = y + G - (D^0 - \hat{D}^2) \quad (S10)$$

Once (P3) and (P5) are solved, the rest of the problem is exactly the same as in the non-grace period case (i.e. (P2)). In the following section, we provide the algorithm for solving (P2), (P3), and (P5).

Algorithm

We begin by highlighting that one can write the optimal consumption of any day within a cycle as a function of the 14th day's optimal consumption per the FOCs for daily consumption. Doing so reduces the number of choice variables in the dynamic programming problem to just the 14th day's consumption and next period debt (and grace period saving in the grace period case). The following algorithm we use assumes that this simplification has been done.

1. Create a grid for the debt level D^I . In the grace period case, create another grid for grace period saving;
2. Solve (P1) on the grid for D^I using the value function iteration method below;
 - (a) take a continuous function $V_0(D^I)$ as the initial guess for $V(\cdot)$
 - (b) solve the maximization problem on the right hand side of (P1) using $V_0(D^I)$
 - (c) use the obtained solution to calculate the value function on the left hand side of (P1), call the result $V_1(D^I)$
 - (d) calculate the sup norm of $V_0(D^I)$ and $V_1(D^I)$
 - (e) if the sup norm is less than some tolerance level, stop; otherwise, update $V_0(D^I)$ using $V_1(D^I)$ and return to (b).

3. Solve the maximization problem in (P2) using $V(D^I)$ on the right hand side of the Bell equation.
4. If there is a grace period, solve (P4) and (P5) using $V(D^I)$. Then solve (P3) using $V^1(D^0, G)$

Model Predictions with Different δ_y Levels

In this section we provide analysis of model predictions on first repayment size and total interest expense with different levels of the yearly exponential discount factor δ_y . To better contrast the effects on repayment of quasi-hyperbolic discounting and exponential discounting, we compute model predictions on first repayment size and total interest expenses with different values of δ_y holding β constant at 1. Figure A3 below plots our results as a function of δ_y , which is analogous to Figure 1 in the main text.

From Figure A3, the size of the first repayment in the grace period case is greater than that in the non-grace period case until δ_y hits some extremely low levels (e.g. 0.01). For those low δ_y values, first repayment size in the grace period case converges to that in the non-grace period case. In fact, our model precisely predicts that to generate a complete waste of the grace period, one has to lower δ_y to 0.008. A similar pattern is seen in interest expense predictions with the only difference being that the agent who has a grace period always pays less interest until δ_y gets extremely low. The interpretation of these results is that the agent keeps making use of the grace period to smooth consumption and save on interest expense until δ_y reaches some extremely low levels.

The essential message from the above observations is that to get similar delay of repayment in the grace period case without present bias, one would have to lower the yearly exponential discount factor to an extreme level such that consumption in the next year gives the agent almost zero value. In contrast, as shown in the main text, the wasted grace period that is consistent with data can be generated by a moderate level of present bias (i.e. $\beta = 0.8$).

Figure A3a: Size of First Repayment

$\beta=1, D^0 = 300$

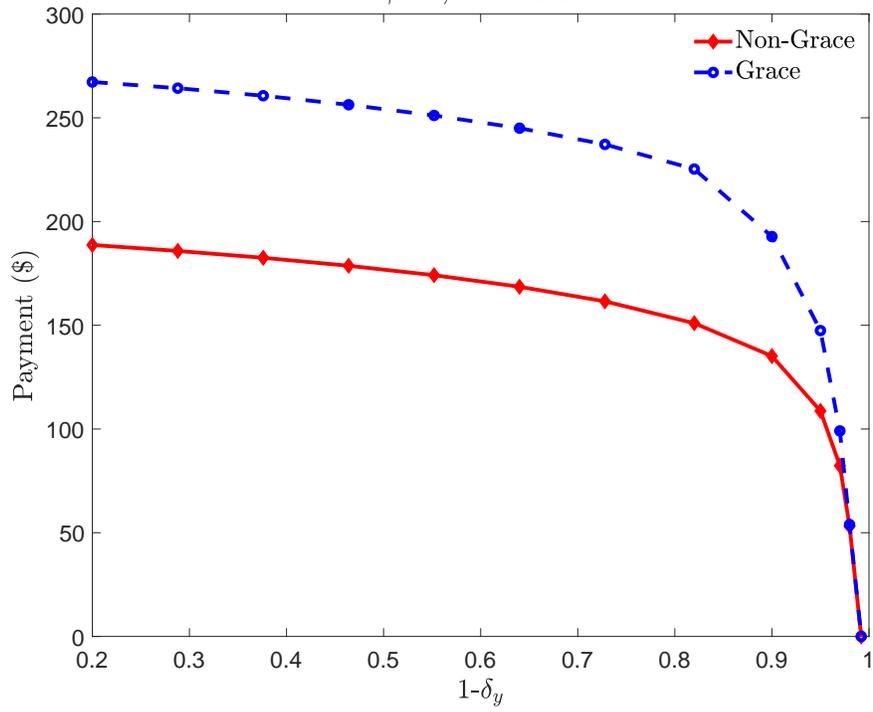
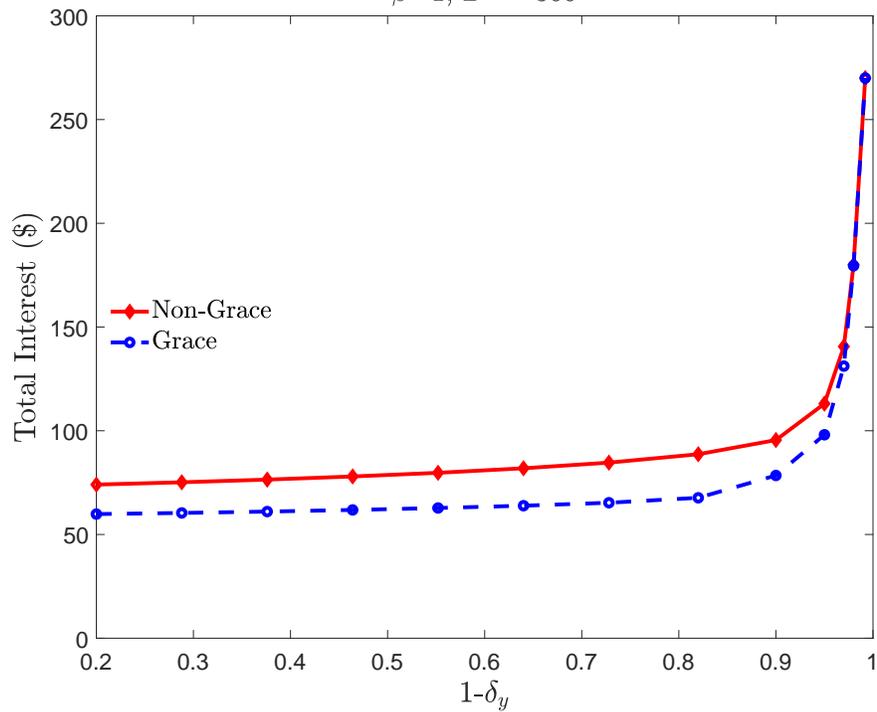


Figure A3b: Interest Paid through 1st Five Due Dates

$\beta=1, D^0 = 300$



Appendix B: Model Predictions with Default

In this section we introduce the possibility of default on the payday loans into the baseline model. Specifically, we introduce the possibility of an unexpected expenditure shock to the agent in the model on the 14th day of each pay cycle, after they make the decision about consumption but before their decisions about how much debt principal to pay down. We assume that the possibility of this shock is not taken into consideration by the borrowers in solving their decision problems. Once hit by this shock, the disposable income of an agent in the model drops immediately by the size of the shock. This setup makes default decisions non-strategic in the sense that the only situation where an agent defaults is when hit by a surprising and large expenditure shock on her due date (i.e. the 14th day) and thus could not afford even paying the interest charges even if she re-borrows to the limit. Though it looks mechanical, we believe that this way of modeling default is in line with the empirical situations that payday borrowers face. To maximize transparency, the following two paragraphs describe the details of our parametrization and modeling strategy of the default components.

First, we calibrate the probability of being caught up by the expenditure shock on the due date to be 0.1. In addition, we assume that shocks across pay cycles are independent. Secondly, we characterize the size of the shock as a fraction of the bi-weekly income, $y = 900$, and the size is randomly drawn from a uniform distribution. We calibrate this uniform distribution to be $U(0, 0.25)$. Let ϵ denote the size of the shock, the resources left for a borrower should a shock hits is as follows:

$$y - \sum_{i=1}^{14} c_i - \epsilon y \tag{B1}$$

Since we maintain the assumption that a borrower can only re-borrow to the initial level of her debt (i.e. $D^I \leq D^0$ holds), the maximum level of money a borrower could access to pay back payday loans after a shock is

$$M_{max}^{shock} \equiv D^0 - D^I + y - \sum_{i=1}^{14} c_i - \epsilon y \tag{B2}$$

When the size of the shock is large enough such that $M_{max}^{shock} < rD^I$ (i.e. the borrower could not afford paying interest even if she re-borrows to D^0), we say that this borrower defaults and her payday loan is written off. After a default, one can no longer access the payday loan market again.

While we assume the expenditure shock process is the same for both non-grace and grace period borrowers, due to the possibility of saving money for later use in the grace period,

we need one more assumption for the first period (i.e. the grace period) in the grace period case. Similarly to the baseline model, we can write the amount saved over the grace period in the presence of a shock as follows:

$$G = y - \sum_{i=1}^{14} c_i - \epsilon y \quad (\text{B3})$$

Though rare, it is possible that when the size of the shock is large, G becomes negative. Since there is no due date in the grace period, the borrower could neither re-borrow nor default. To handle this issue, we make the assumption that when $G < 0$ happens, the negative amount gets carried over to the next pay check. To be more clear, let y^1 denote the income of the period right after the grace period, we have that

$$y^1 = \begin{cases} y & \text{if } G \geq 0 \\ y + G & \text{if } G < 0 \end{cases}$$

The consequence of this assumption is that when hit by a large enough shock such that $G < 0$ holds, borrowers in the grace period case delay repayment even more due to the fact that they enter their first normal pay cycle with income that is less than the usual one. We find that this consequence is quantitatively insignificant under our calibration of the expenditure shock process. The underlying reason is that $G < 0$ is a rare event, so its effect is minimal when we compute the aggregate averages.

To obtain model predictions of repayment and default patterns, we simulate the model to construct a panel of 10,000 borrowers. Each borrower starts with the same level of initial debt D^0 and has the same income process. However, the expenditure shock realization is heterogeneous and independent across all borrowers. For each borrower in the panel, we simulate a 15-pay-cycle path of repayment and default decisions. We then compute the economy-wide averages of repayment and default behaviors to obtain model analogs of the corresponding empirical measurements. The results of the model simulations are presented in Figure B1 below.

The conclusion we draw here is that model predictions on repayment and default are largely consistent with the empirical observations. One thing to highlight is that our model is able to capture the empirical fact that default rate in the grace period case eventually surpasses the one in the non-grace period case. Through the lens of the model, this is a direct results of the persistent push-off of repayment in the grace period case. Specifically, since grace period borrowers push off their repayment relative to the non-grace period borrowers, they end up with more debt outstanding for each pay cycle after the grace period. Therefore, facing the same expenditure shock process, the grace period borrowers have a higher likelihood to

default for each period after the grace period.

Figure B1a: Avg. Fraction of Initial Debt Paid

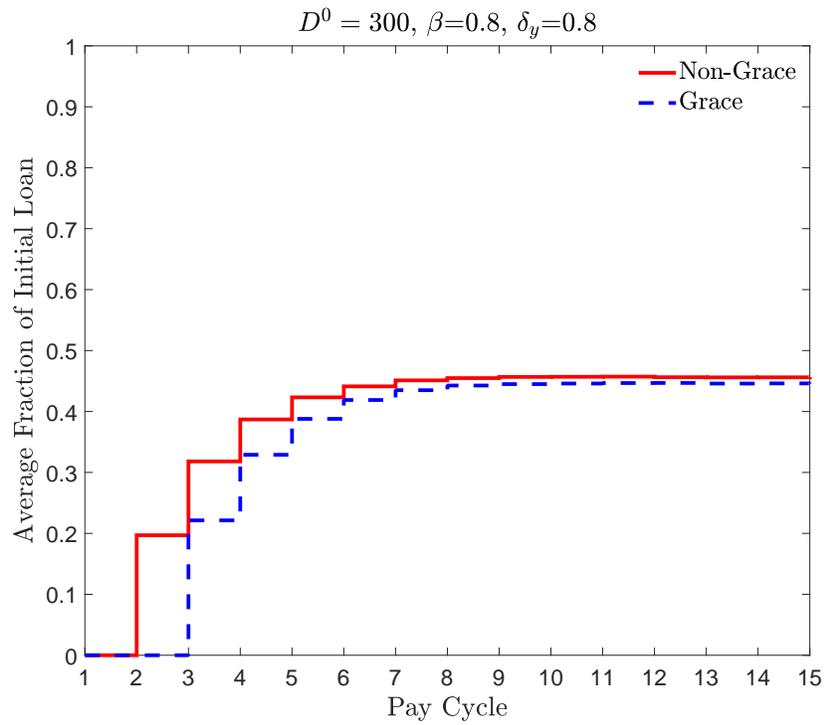
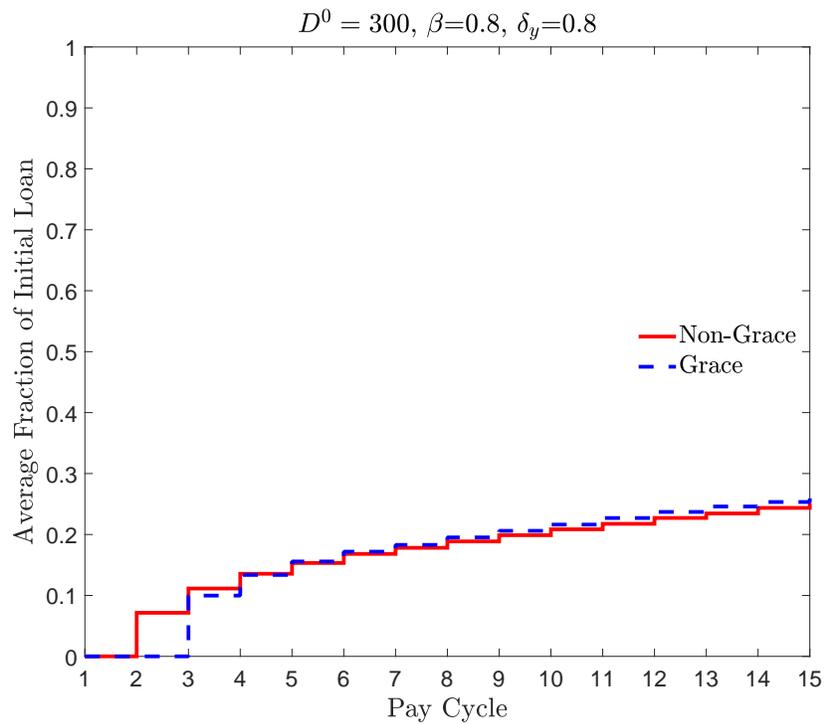
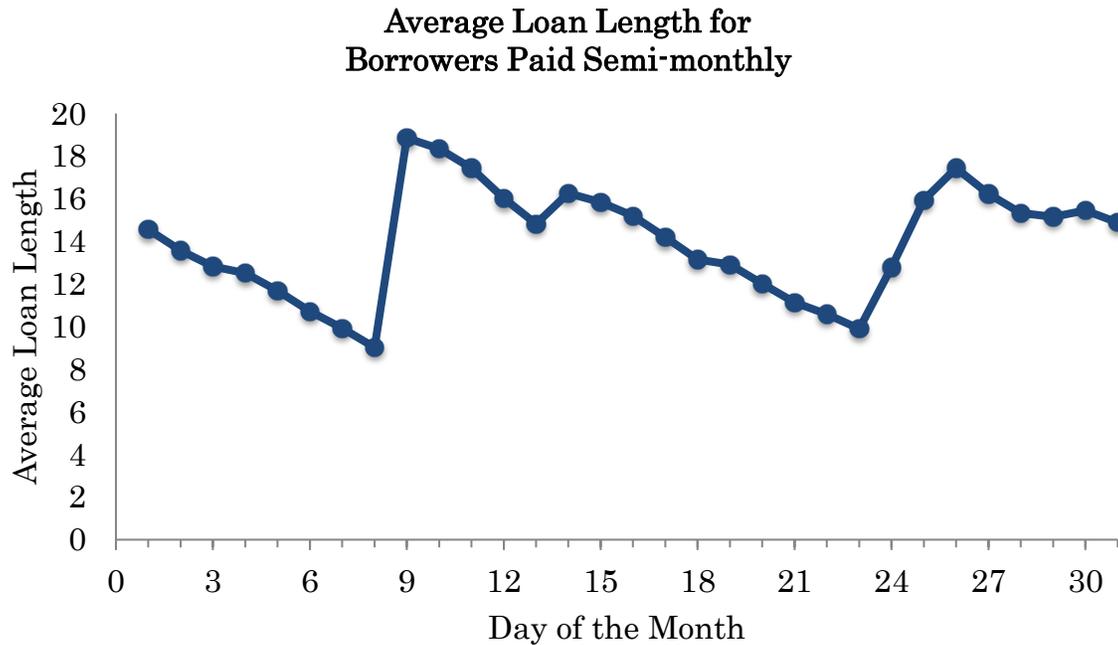


Figure B1b: Avg. Fraction of Loan Defaulted



Appendix C: Empirical Results for Borrowers Paid Semi-monthly

Appendix Figure C1: Loan Length



Notes: Authors' calculations based on payday loan transaction data in Texas from November 2001 until August 2004. The figure reports the average loan length for borrowers paid semi-monthly. The minimum amount of time a borrower can take out a loan is seven days. If a borrower arrives at the lender with fewer than seven days until her next payday, the loan length is equal to the number of days until that payday plus the time until the next loan. The figure reports the average loan length for each day of the month for all borrowers in the sample who are paid semi-monthly.

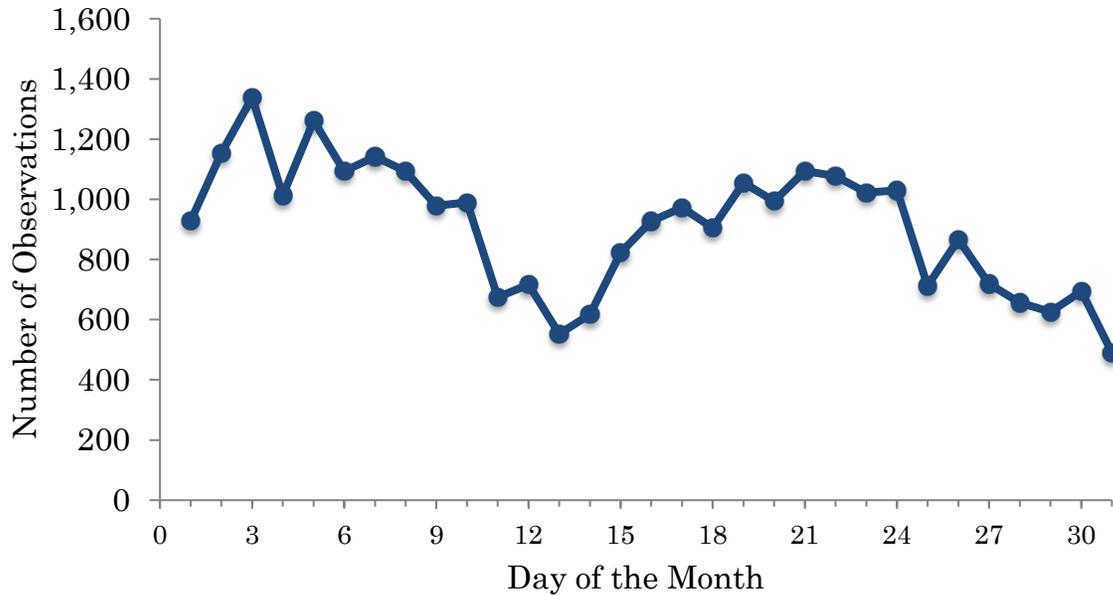
Appendix Table C1: Summary Statistics for Borrowers Paid Semi-monthly

	(1)	(2)
	Semi-monthly Sample	Semi-Monthly Sample (Restricted to the 8th and 9th of the Month)
Borrower Characteristics for Initial Loans		
Age	35.98 (9.96)	35.85 (9.92)
Female	68.84%	67%
White	25.29%	29%
Black	40.48%	40%
Hispanic	33.06%	30%
Race, other	1.17%	1%
Fraction homeowners	37.53%	35%
Direct deposit	75.44%	77%
Annualized net pay (\$)	24,238.66 (9,622.45)	24,416 (9,566.45)
Checking balance (\$)	329.10 (482.99)	328.92 (467.57)
Credit Score	543.75 (210.13)	545.63 (208.29)
Initial Loan Characteristics		
Principal of Initial Loan (\$)	324.87 (139.96)	311.71 (140.74)
Interest Due on Initial Loan (\$)	58.48 (25.19)	56.11 (25.33)
Initial Loan length (days)	13.67 (4.61)	13.66 (6.66)
Initial Loan Outcomes		
Principal paid on first loan	92.92 (159.63)	92.27 (160.29)
Rolled over some of the loan at first due date	0.66	0.64
Number of Effective Rollovers in Loan Spell	2.90 (4.27)	2.90 (4.26)
Total Finance Charges Paid in Loan Spell	217.34 (287.58)	217.34 (273.01)
Loan Spell Ended with Default	0.19	0.19
Total Number of Initial Loans	28,213	2,072
Total Number of Loans (including Rollovers)	110,042	8,082

Notes: Averages of all variables shown, with standard deviations in parentheses for continuous variables. Data are based on authors' calculations from administrative data from a large payday lender in Texas from 2000-2004. Initial loans are loans where the borrower did not have a loan outstanding for at least 32 days prior to initiation. Our administrative records do not include demographic information for all borrowers, and we have gender, race, and home ownership information for around 50% of the sample.

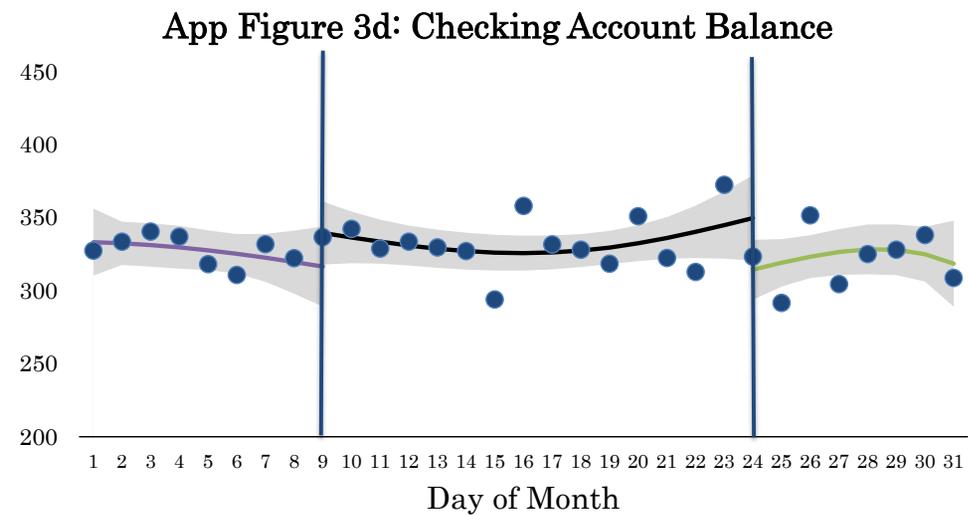
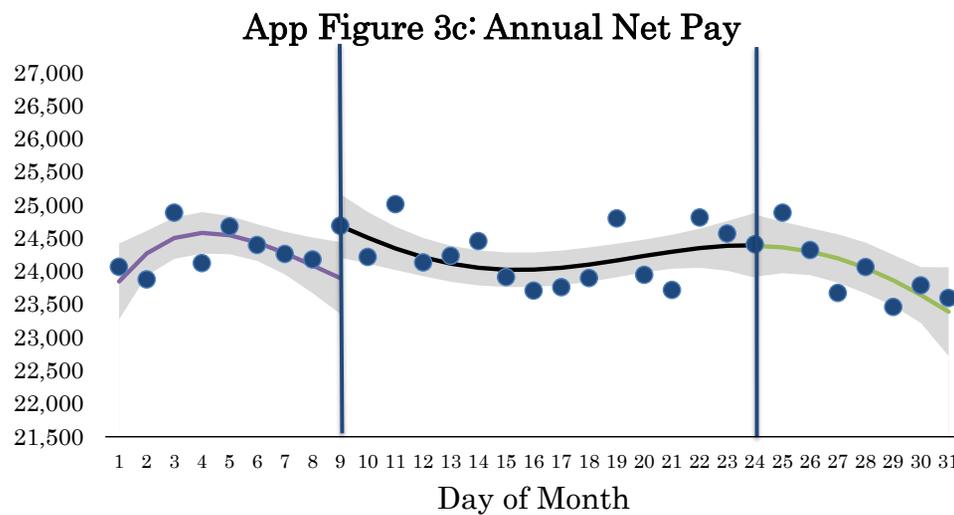
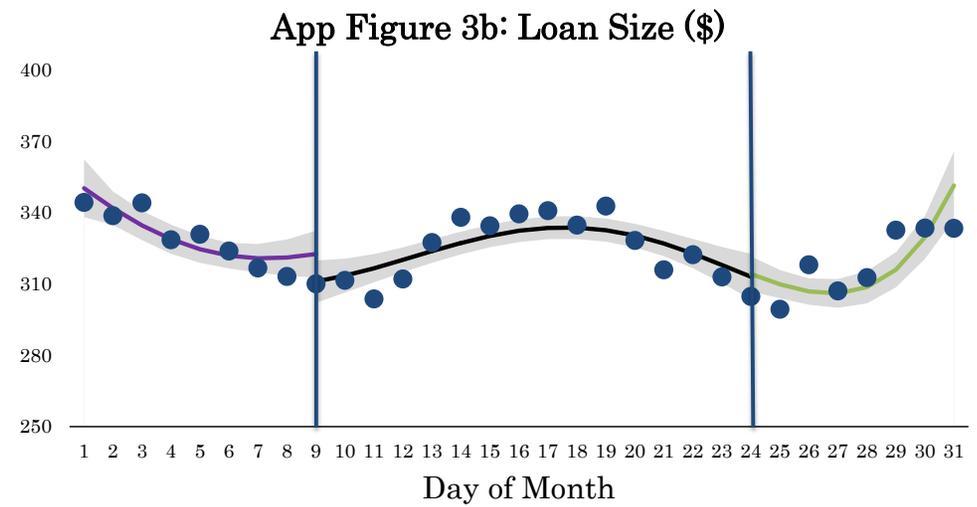
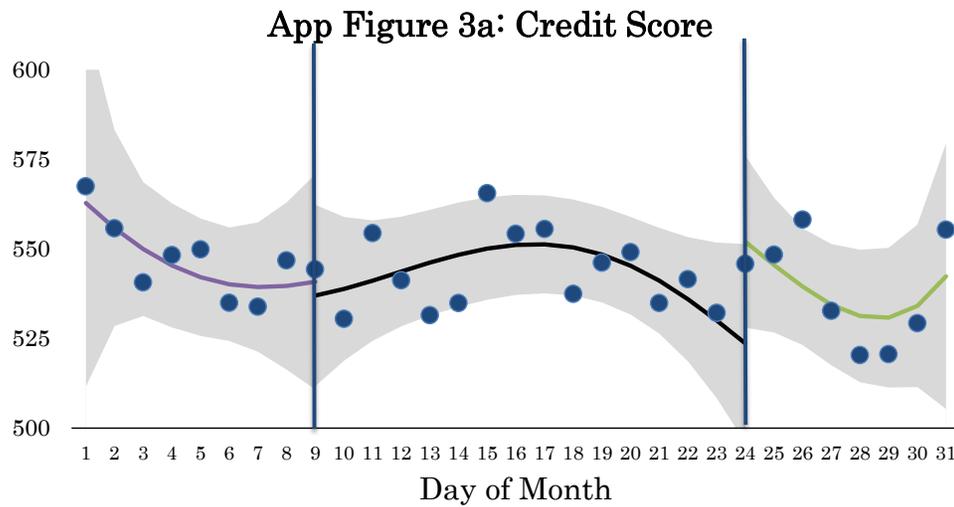
Appendix Figure C2: Loan Observations

**Number of Observations for Borrowers Paid
Semi-monthly**



Notes: Authors' calculations based on payday loan transaction data in Texas from November 2001 until August 2004. The figure reports the number of observations for borrowers paid semimonthly for each day.

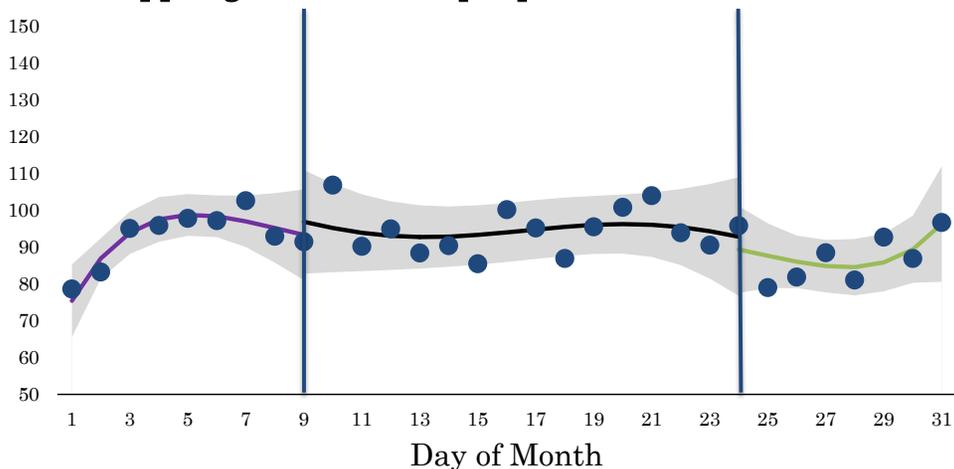
Appendix Figure C3: Graphs for Key Control Variables for Borrowers Paid Semi-monthly



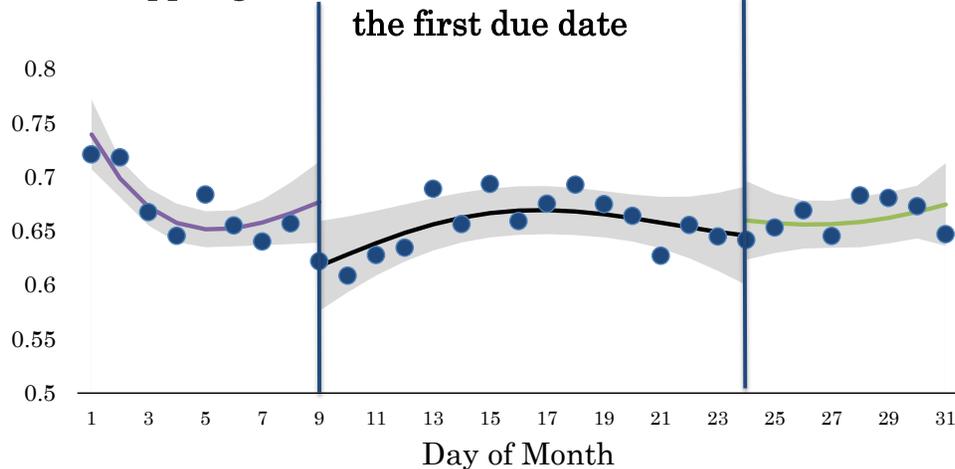
Notes: Authors' calculations based on payday loan transaction data in Texas from November 2001 until August 2004. The vertical line marks six days until payday, i.e., the day in the pay cycle where the borrower experiences a discontinuous increase in loan length. Dots on the graph represent the averages of each outcome (in the figure heading) for each day of the month. The curve shows the predicted outcomes from the regression results of the outcome variable on the day of the month raised to the fifth, as well as an indicator for a borrower taking out a loan on the 9th or 24th of the month. The curve to the left of the line is the predicted outcome without an indicator for six or fewer days until payday. The curve to the right of the line maps the predicted outcomes including the dummy for less than six days until payday. 95% confidence intervals are included in gray.

Appendix Figure C4: Outcomes Borrowers Paid Semi-monthly

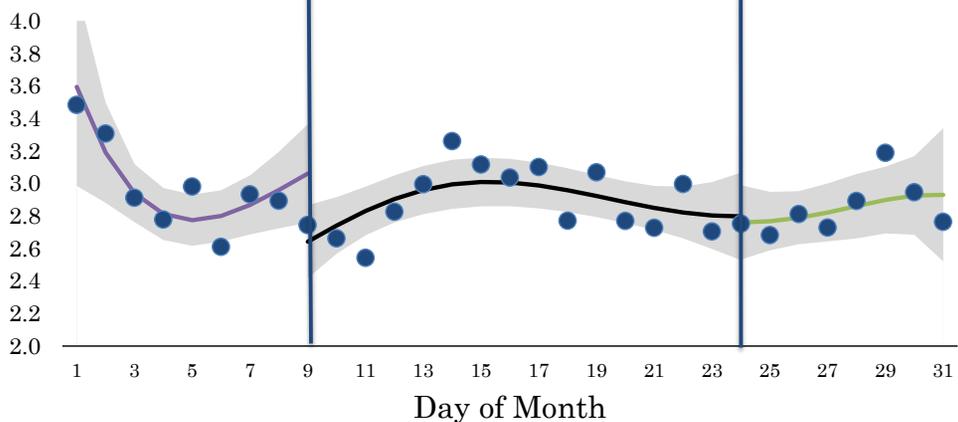
App Figure 4a: Principal paid on first due date



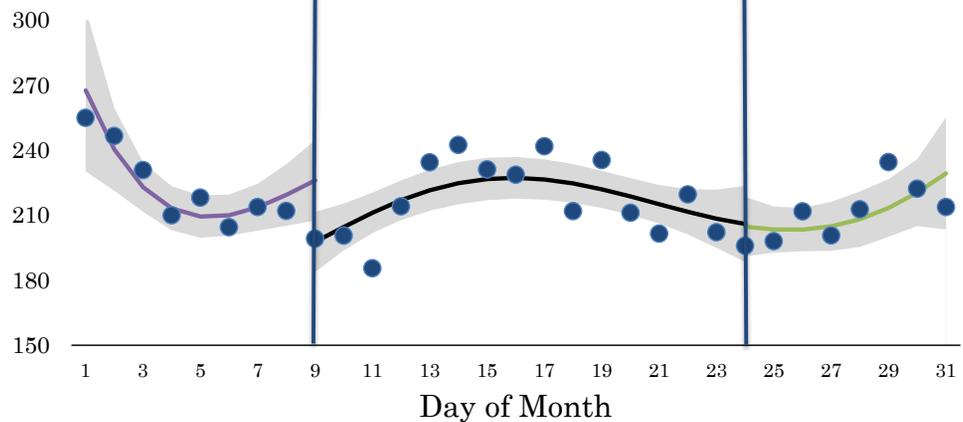
App Figure 4b: Rolled over some of the loan at the first due date



App Figure 4c: Number of effective rollovers in loan spell



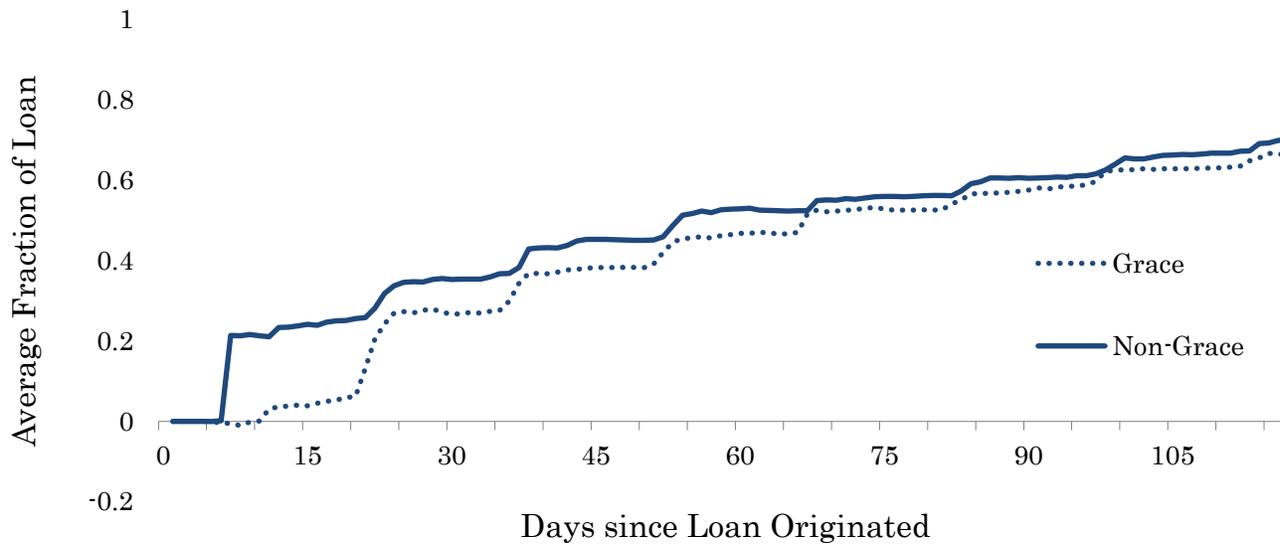
App Figure 4d: Total finance charges paid in loan spell



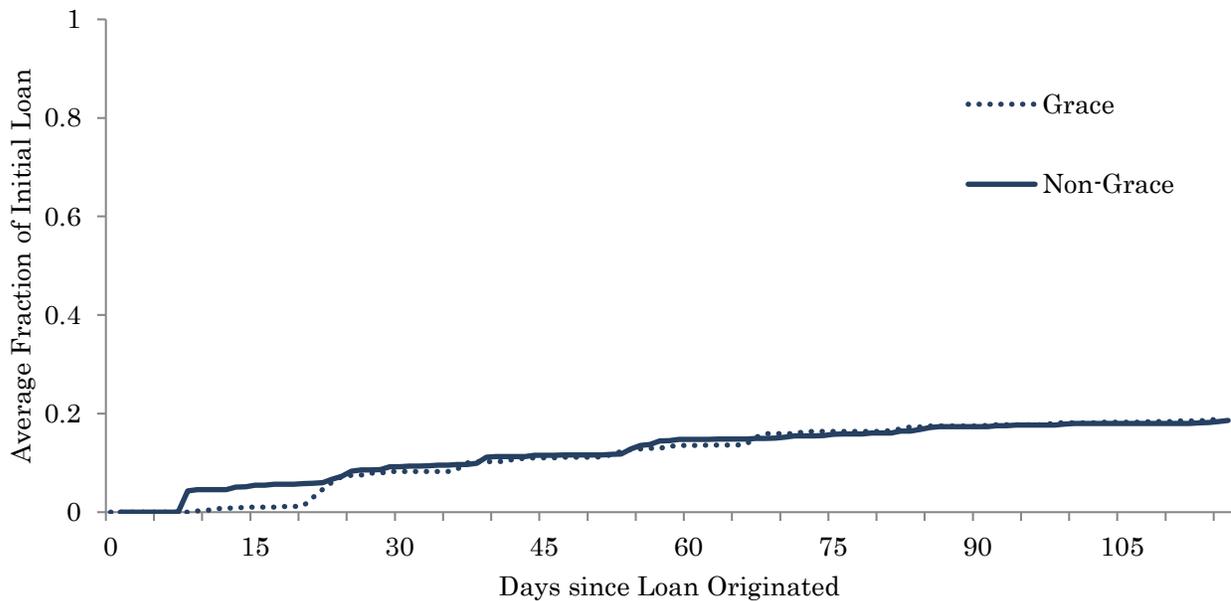
Notes: Authors' calculations based on payday loan transaction data in Texas from November 2001 until August 2004. The vertical line marks six days until payday, i.e., the day in the pay cycle where the borrower experiences a discontinuous increase in loan length. Dots on the graph represent the averages of each outcome (in the figure heading) for each day of the month. The curve shows the predicted outcomes from the regression results of the outcome variable on the day of the month raised to the fifth, as well as an indicator for a borrower taking out a loan on the 9th or 24th of the month. The curve to the left of the line is the predicted outcome without an indicator for six or fewer days until payday. The curve to the right of the line maps the predicted outcomes including the dummy for less than six days until payday. 95% confidence intervals are included in gray.

Appendix Figure C5: Debt Repayment and Default Over Time Borrowers Paid Semi-monthly

App Figure 5a: Average Fraction of Initial Loan Repaid



App Figure 5b: Average Fraction of Initial Loan Defaulted



Notes: Authors' calculations based on payday loan transaction data in Texas from November 2001 until August 2004. Figure C5a shows the average fraction of initial loan repaid by days since loan originated. Figure C5b shows the average fraction of initial debt defaulted on by days since loan started. We separate borrowers by the discontinuity in loan lengths. We show borrowers who arrive on the eighth of the month and likely have seven days before their payday and get a seven day loan ("Non-Grace") and borrowers who arrive on the ninth day of the month (six days before their predicted payday) and therefore receive a 20-day loan ("Grace").

Appendix Table C2: Control Variables as Outcomes for Borrowers Paid Semimonthly

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Subprime Credit Score	Loan Amount	Net Pay	Account Balance	Direct Deposit	Age	Female	Black / Hispanic	Home Owner
Sample Restricted to Origination Date on 8th and 9th Day of Month									
Mean	545.63	311.71	24,415.79	328.92	0.77	35.85	0.67	0.70	0.35
Grace (9th Day of the Month)	-2.46 (9.11)	-3.06 (6.24)	510.57 (421.75)	14.43 (20.83)	0.004 (0.02)	0.39 (0.43)	0.01 (0.03)	-0.04 (0.03)	-0.02 (0.03)
N	2,072	2,072	2,072	2,072	2,072	2,071	899	894	967

Notes: Data are based on authors' calculations from administrative data from a large payday lender. OLS regressions shown for subprime credit score, loan amount, net pay, account balance, direct deposit indicator, age, female indicator, black or hispanic indicator, and homeowner indicator. The sample is restricted to borrowers paid semimonthly with a payday loan origination date on the 8th or 9th day of the month. The sample includes individuals who are missing information on age, gender, race, and home ownership, which is reflected in the changing number of observations in columns six through nine. Standard errors are clustered at the individual level and are reported in parentheses below the coefficients. ***, **, and * designates statistical significance at the 1%, 5%, and 10% level, respectively.

**Appendix Table C3: Regression Results for Semimonthly Sample
Restricted to Origination Date on the 8th and 9th of the Month**

	(1)	(2)	(3)	(4)
	Principal paid on first due date	Rolled over some of the loan at first due date	Number of Effective Rollovers in Loan Spell	Total Finance Charges Paid in Loan Spell
Panel A: Semimonthly Sample Restricted to Origination Date on the 8th and 9th of the Month				
Mean	92.27	0.64	2.82	205.89
Grace (9th Day of the Month)	-1.52 (5.20)	-0.04** (0.02)	-0.30** (0.15)	-22.74** (9.73)
Other Controls?	Yes	Yes	Yes	Yes
N	2,072	2,072	1,847	1,847
R ²	0.15	0.08	0.06	0.08

Panel B: First Observations of Semimonthly Sample

Mean	88.66	0.63	2.86	201.46
Grace (9th Day of the Month)	1.06 (6.52)	-0.02 (0.03)	-0.16 (0.12)	-18.99 (11.80)
Other Controls?	Yes	Yes	Yes	Yes
N	944	944	821	821
R ²	0.18	0.12	0.11	0.11

Notes: Data are based on authors' calculations from administrative data from a large payday lender. OLS regressions shown for four outcomes: Principal Paid on first due date calculates the amount of the loan paid by the first due date; Rolled over some of the loan at first due date indicates that the borrower rolled over the loan at the first due date; Number of Effective Rollovers is a variable that counts the number of additional loans in succession by a borrower; and Total Finance is the total finance charged over the loan cycle. Panel A includes borrowers paid semimonthly and restricts the sample to loans with an origination date on the 8th or 9th day of the month. Panel B includes the sample in Panel A but only uses the first observation for each borrower. Controls in all columns include loan size, gender, net pay per year, checking account balance, subprime credit score, and age bins. Dummies for race (white, black, Hispanic, or other), having loans direct deposited, or missing control variables are also included. Columns 3-4 include fewer observations because we did not include loans initiated with less than 5 pay periods before the end of our sample so as to not artificially truncate these outcomes. Standard errors are clustered at the day the loan was initiated and are reported in parentheses below the coefficients. ***, **, and * designates statistical significance at the 1%, 5%, and 10% level, respectively.

Appendix Table C4: Regression Results with and without Controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Principal paid on first due date		Rolled over some of the loan at first due date		Number of Effective Rollovers in Loan Spell		Total Finance Charges Paid in Loan Spell	
Panel A1: All Biweekly Borrowers								
Mean	85.74		0.67		3.11		219.69	
Grace (<Seven Days until Payday)	-6.18 (4.70)	-1.60 (3.42)	-0.01 (0.01)	-0.02** (0.01)	-0.37*** (0.11)	-0.35*** (0.09)	-18.36*** (6.59)	-17.62*** (5.80)
Cubic in Days Until Payday	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other Controls?	No	Yes	No	Yes	No	Yes	No	Yes
N	79,098	79,098	79,098	79,098	71,920	71,920	71,920	71,920
R ²	0.00	0.11	0.003	0.04	0.002	0.03	0.00	0.07
Panel A2: Sample Restricted to Origination Date Six and Seven Days until Payday								
Mean	88.84		0.64		2.98		208.55	
Grace (Six Days until Payday)	-6.92 (4.23)	-3.55 (3.12)	-0.00 (0.01)	-0.01 (0.01)	-0.35*** (0.09)	-0.34*** (0.09)	-17.40*** (5.54)	-16.34*** (5.23)
Other Controls?	No	Yes	No	Yes	No	Yes	No	Yes
N	15,491	15,491	15,491	15,491	14,073	14,073	14,073	14,073
R ²	0.00	0.11	0.00	0.05	0.001	0.03	0.00	0.06
Panel B1: All Semimonthly Borrowers								
Mean	92.92		0.66		2.90		217.34	
Grace (Post-8th of the Month)	3.55 (11.36)	8.16 (7.52)	-0.06* (0.03)	-0.06*** (0.02)	-0.42* (0.23)	-0.41** (0.17)	-28.33** (14.31)	-25.10** (11.66)
Fifth-Order Polynomial in Day of Month	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other Controls?	No	Yes	No	Yes	No	Yes	No	Yes
N	28,213	28,213	28,213	28,213	25,157	25,157	25,157	25,157
R ²	0.00	0.11	0.002	0.05	0.001	0.03	0.00	0.08
Panel B2: Sample Restricted to Origination Date on 8th and 9th Day of Month								
Mean	92.27		0.64		2.82		205.89	
Grace (9th Day of the Month)	-1.50 (11.16)	-1.52 (5.20)	-0.03 (0.04)	-0.04** (0.02)	-0.15 (0.25)	-0.30** (0.15)	-12.73 (15.46)	-22.74** (9.73)
Other Controls?	No	Yes	No	Yes	No	Yes	No	Yes
N	2,072	2,072	2,072	2,072	1,847	1,847	1,847	1,847
R ²	0.00	0.15	0.001	0.08	0.00	0.06	0.00	0.08

Notes: Data are based on authors' calculations from administrative data from a large payday lender. OLS regressions shown for four outcomes: Principal Paid on first due date calculates the amount of the loan paid by the first due date; Rolled over some of the loan at first due date indicates that the borrower rolled over the loan; Number of Effective Rollovers is a variable that counts the number of additional loans in succession by a borrower; and Total Finance is the total finance charged over the loan cycle. Panel A1 controls for whether the origination date of the loan was less than seven days until the borrower's next payday. We control for days until paid with a cubic polynomial. Panel A2 restricts the sample to borrowers who have an origination date six or seven days before their payday. Panel B does a similar analysis for semimonthly borrowers. Panel B1 includes a dummy for the origination date being after the 8th of the month (where the discontinuity lies), and we control for day of the month with a fifth-order polynomial. Panel B2 restricts the sample to loans with an origination date on the 8th or 9th day of the month. Controls in columns (2), (4), (6), and (8) include loan size, gender, net pay per year, checking account balance, subprime credit score, and age bins. Dummies for race (white, black, Hispanic, or other), having loans direct deposited, or missing control variables are also included. Columns 5-8 include fewer observations because we did not include loans initiated with less than 5 pay periods before the end of our sample so as to not artificially truncate these outcomes. Standard errors are clustered at the day the loan was initiated and are reported in parentheses below the coefficients. ***, **, and * designates statistical significance at the 1%, 5%, and 10% level, respectively.

Appendix D: Effects of a One-Time Income Drop

In this section, we use the model to explore the effects of an expenditure shock that cannot be fully covered by the initial pay day loan. This type of situation would cause the marginal value of income to be higher in the initial aftermath of the loan being originated. We can simulate this type of situation by lowering the income available to the agent in the model during the first pay period. We can think of this either as a true income shock or as representing the lingering effects of an unavoidable expenditure shock that does not generate consumption utility. The purpose of this experiment is to show whether some other economic mechanisms that do not involve naive present bias are able to rationalize the data patterns on repayment.

To explore this issue we modify the baseline model by reducing the income for the agent by 30% in the first pay cycle. That is, the agent only has \$630 at her disposal in the first pay cycle. In all subsequent pay cycles, her income goes back up to \$900. The results of this experiment are summarized in Figure D1a and Figure D1b.

The take-aways of this experiment are clear when we compare Figure D1 below with Figure 2 in the main text. First, as suggested by the comparison between Figure 2a and Figure D1a, when there is no present bias, lower income in the first pay cycle makes those with and without a grace period less willing to pay down their balance on the first due date. While less income in the first cycle makes the non-grace period case agent only pay down a little on the first due date, it also makes the grace period agent not willing to save much in the grace period. The effect of income drop together with the concomitant procrastination effect of a moderate present bias drives the results shown in Figure D1b. Due to the joint effect of income drop and present bias, the non-grace period case agent pays down nothing in the first cycle while the grace case agent saves nothing in the grace period. Hence they both enter the second pay cycle with exactly the same conditions (i.e. same levels of disposable income and debt). This then explains their identical repayment behavior as in Figure D1b.

The conclusion we draw from this experiment is that income drop in the first pay cycle does not have a “shock hangover” effect that could help rationalize the empirical patterns of repayment. Essentially, this is because the drop of income causes delays of repayment for both types of agents. One thing to highlight is that although the 30% income drop we use seems arbitrary, its effect on repayment is generalizable across all levels of income drops. Based on our results, one can predict that with a bigger (smaller) income drop, the non-grace period case agent would pay down less (more) in the first pay cycle and the grace case agent would save less (more) in the grace period.

Figure D1a: Fraction of Debt Left w/o Present Bias, 30% Income Drop

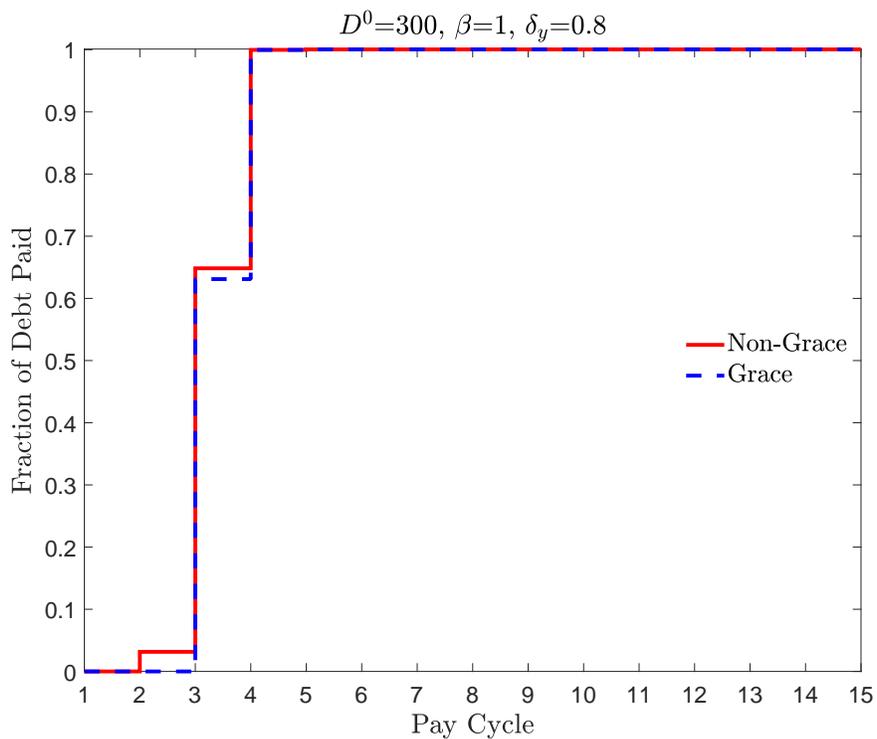
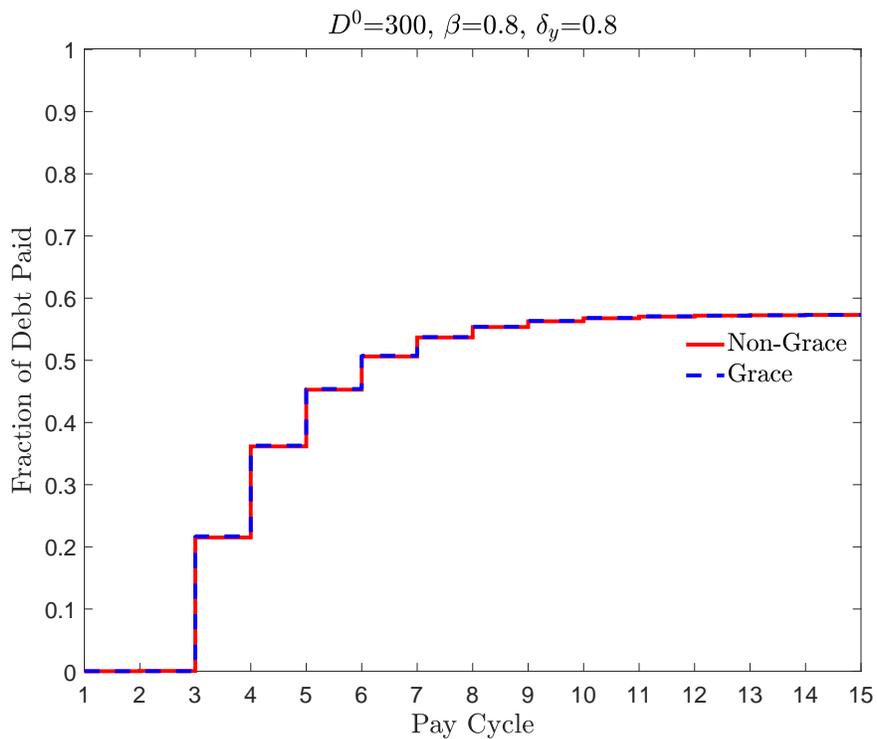


Figure D1b: Fraction of Debt Left w/ Present Bias, 30% Income Drop



Appendix E: Effects of an Anticipated One-Time Future Income Increase

To further check the robustness of the naive present bias mechanism we emphasize in our baseline model, we conduct another experiment to see the effects of an expected one-time future income rise on repayment, absent naive present bias. We begin by introducing a set of different levels of anticipated income increases that are fractions of the regular bi-weekly income $y = 900$. Following that we add differences on the timing of this anticipated future income rise. Figure E1 below shows the results of repayment when we combine different levels of income increases and different timing of the increases.

We see from Figure E1 that in both the non-grace and grace cases, the anticipation of an income increase scales up the consumption for periods before the realization of the income increase. The most salient increase in consumption takes place during the pay cycle previous to the one where the income increase is realized. This consumption scale-up is the result of a pure wealth effect induced by the expected increase of income on a future date. To put it into perspective, take as an example the case where there is a 25% expected rise at the beginning of the third pay cycle (i.e. the situation represented by the second plot on the second row of E1a). In this case both type of agents choose to consume much more during the second pay cycle and thus pay down much less debt balance during that period compared to the prediction in the baseline model without present bias, which is shown in Figure 2a. The repayment pattern of the grace period case during the third pay cycle is indeed a full push off as observed in the data. However, since there is no present bias, both types of agents optimally choose to pay down much more debt balance after they get the additional income. In other words, the push off of the grace period case does not persist as seen in the data. This short-lived push off in the grace period case is purely generated by the consumption increase before the income rise. However, when the income rise is realized, the agents without present bias would take full advantage of a temporarily relaxed budget constraint to pay down more debt.

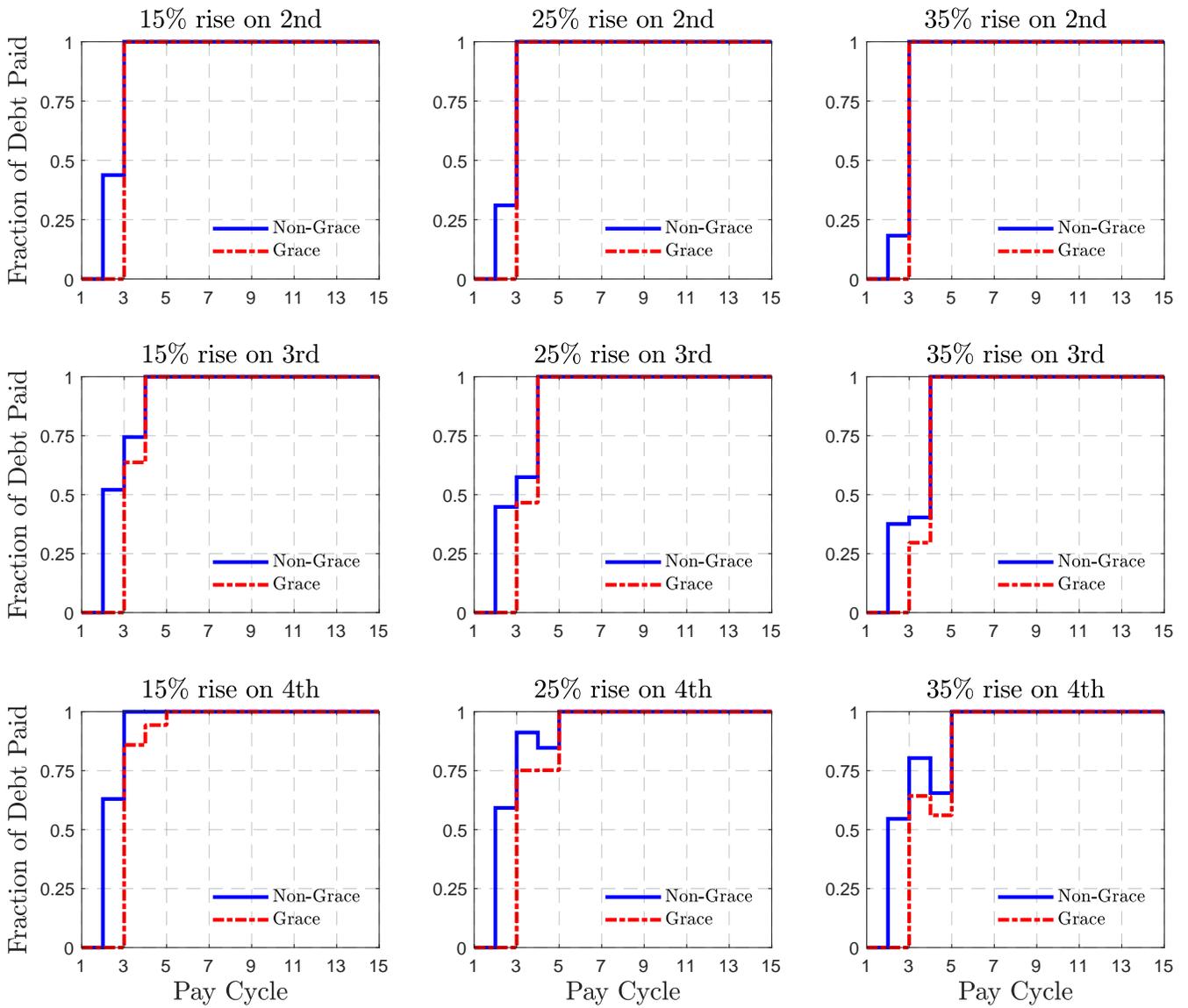


Figure E1a: Repayment Patterns w/ $D^0 = 300$, $\beta = 1$, $\delta_y = 0.8$

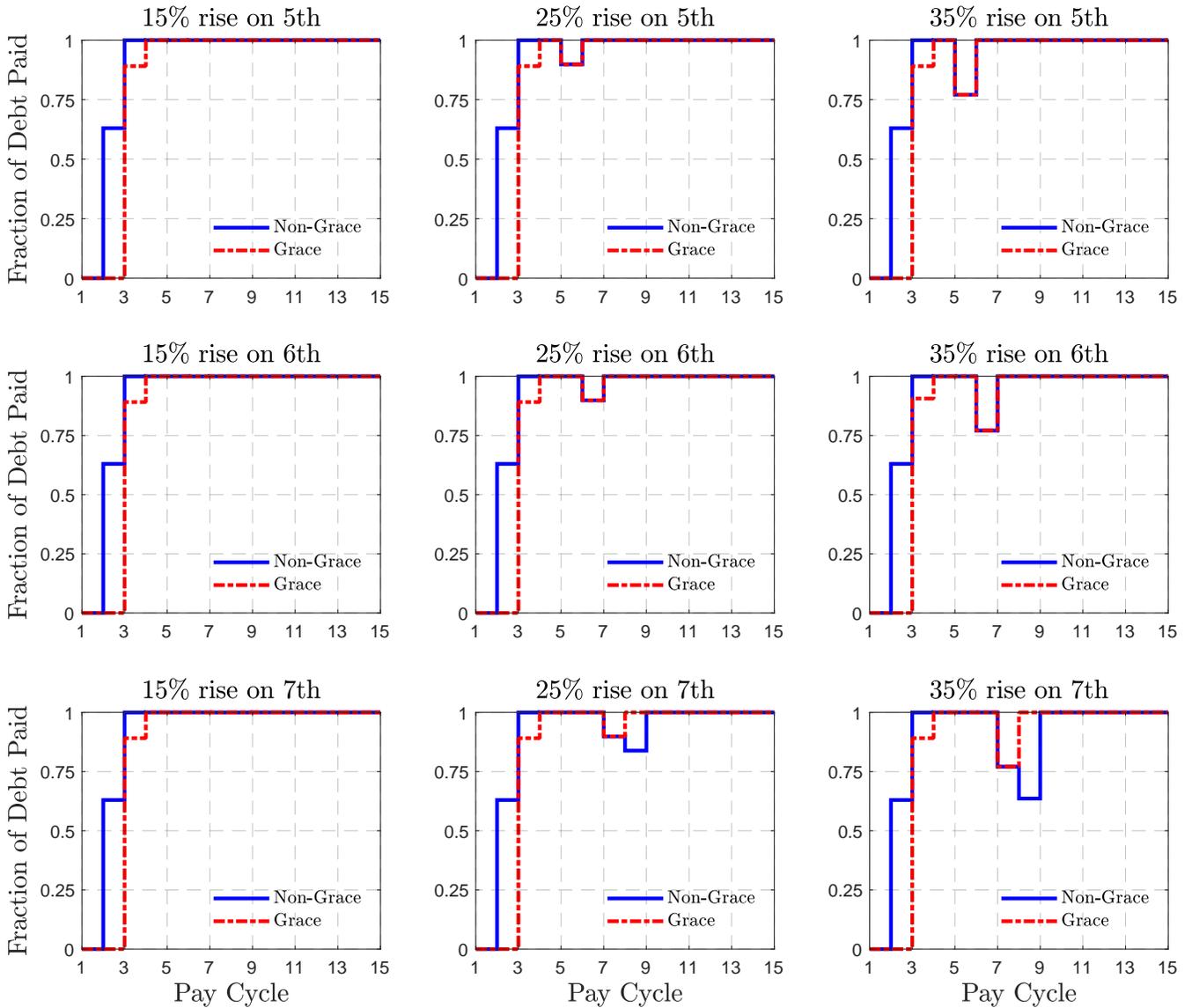


Figure E1b: Repayment Patterns w/ $D^0 = 300$, $\beta = 1$, $\delta_y = 0.8$

The second question we address in the experiment is the heterogeneity among borrowers in terms of magnitude and timing of their anticipated future income rises. To do this we assume that different groups in the population get different levels of income increases at different times. Therefore, the aggregate repayment pattern is a weighted average of the individual repayment patterns in different groups. The motivation of this exercise is as follows. Even though the individual cases we analyze in Figure E1 cannot generate a persistent delay of repayment in the grace period case, it may be possible to get this persistent delay by combining the cases in E1 in a certain way. After all, borrowers in the real world are subject to different situations. Figure E2 below shows the predicted aggregate repayment patterns under four different scenarios of dividing the population. In each of the four scenarios, we

divide the whole population into multiple subgroups. For each of the subgroups, we feed in a combination of magnitude and timing of anticipated future income increase. For instance, in E2a the population is divided into two subgroups; and each subgroup consists of half of the population. For the first half, we give them an anticipated income boost at the beginning of the third pay cycle that is equal to 15% of the periodical paycheck amount y . For the other half, we keep the arrival time of the income increase the same but change its magnitude to 35% of y .

The conclusion we draw from the results in Figure E2 is that accounting for borrower heterogeneity in terms of magnitude and timing of their anticipated future income rises could not rationalize the data repayment patterns. The reason for that is twofold. First, both grace and non-grace period borrowers without any present bias will use the additional resource to pay down much more debt right after the income rise is actually realized. So the repayment push offs of grace period borrowers are always short-lived as opposed to persistent like in the data. In other words, the consumption scale-up before realizations of income rises might generate some push offs of repayment for the grace period case for some periods. However, regardless when the income rise comes by, the grace period borrowers will always "catch up" immediately after it. Furthermore, time-consistent preferences embedded in both types of borrowers in this experiment always ensure that the borrowers pay off all of the debt after income rises, regardless of the timing of the income rises. This feature goes against the empirical observation that payday loan borrowers roll over their initial debt balance for a long period of time.

Figure E2a: Repayment Patterns w/ Borrower Heterogeneity, $D^0 = 300$, $\beta = 1$, $\delta_y = 0.8$

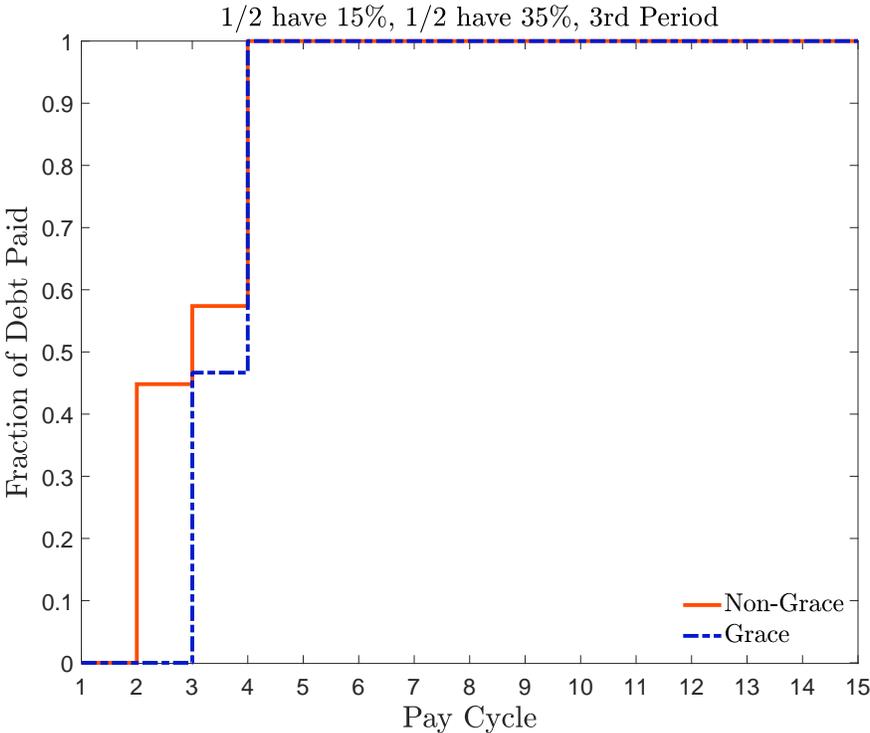


Figure E2b: Repayment Patterns w/ Borrower Heterogeneity, $D^0 = 300$, $\beta = 1$, $\delta_y = 0.8$

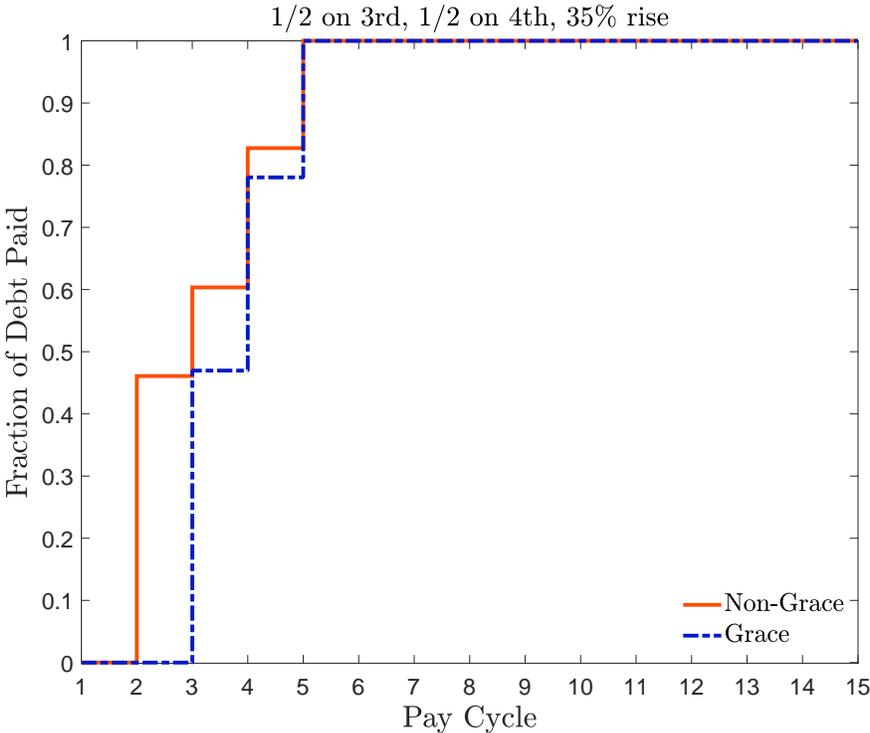


Figure E2c: Repayment Patterns w/ Borrower Heterogeneity, $D^0 = 300$, $\beta = 1$, $\delta_y = 0.8$

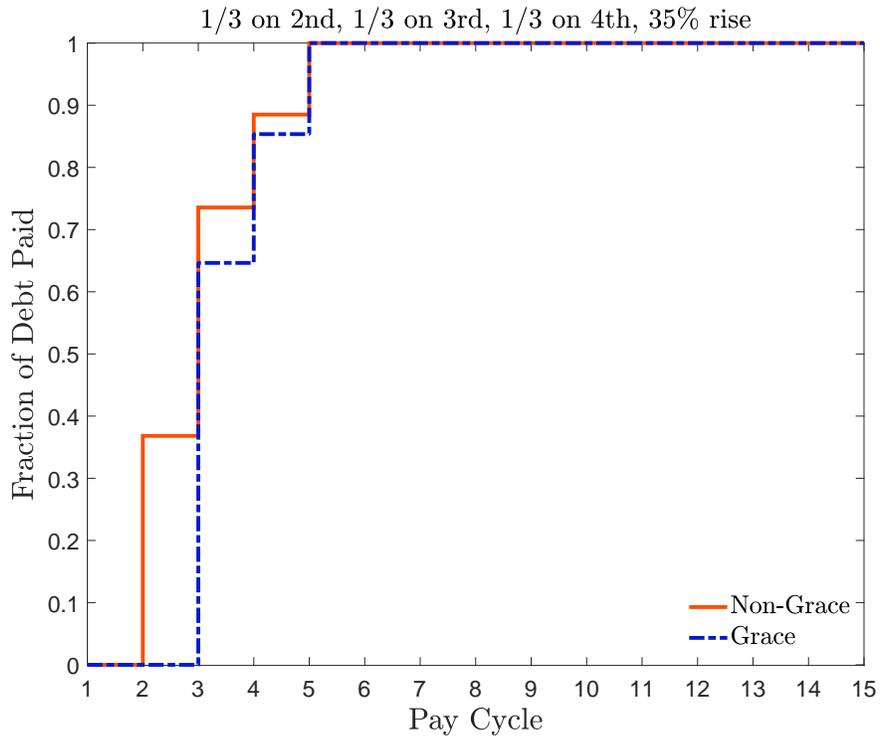


Figure E2d: Repayment Patterns w/ Borrower Heterogeneity, $D^0 = 300$, $\beta = 1$, $\delta_y = 0.8$

