Essays on Decisions Involving Recurring Financial Events

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ABSTRACT

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This dissertation explores what influences consumer financial decisions with consequences that recur over time, such as mortgages and recurring payment plans in contracts. This dissertation investigates two questions: (1) How do individual differences in intertemporal preferences influence how consumers think about recurring financial events? (2) How does the aggregation level used to describe the recurring financial consequences impact how consumers mentally represent the purchase? Taken together, this dissertation explores how consumers mentally represent recurring outcomes and express these preferences through choice.

The first essay explores the relationship between individual differences in time preferences and decisions involving recurring payments in the domain of mortgage choices. It relates two components of an individual's time preference, a present bias (overvaluing immediate outcomes), and a personal discount rate (the exponential component of time preferences), to mortgage selection and the decision to strategically abandon a home worth less than its mortgage.

Combining insights from an analytic model and a survey of 244 mortgaged households augmented by zip-code market house price data, this essay proposes that consumers with greater present bias and exponential discounting are more likely to choose mortgages that minimize up-front costs and be underwater. This model also suggests that present bias decreases the likelihood of walking away, but that higher discounting increases that likelihood, a result consistent with

the data. Time preferences remain robust predictors with individual and market-level controls, and alternate model specifications.

The second essay explores how the aggregation level of a recurring price (e.g. on a daily vs. a yearly basis) impacts how consumers mentally account for a contract's benefits. For example, if consumers are told the daily price of a car lease, they imagine the daily benefits of the car, and when they are told a monthly price they imagine their broader use of the car. This essay builds on the "pennies-a-day" model (Gourville 1998), which posits that narrowly framed recurring costs can increase a consumer's willingness to purchase by making the cost of a purchase seem trivial. The essay will present evidence that triviality is neither a necessary nor sufficient condition for narrow framing to increase willingness to purchase and expand the domain of situations where such narrow framing increases purchase. Five web-based experiments suggest that scope insensitivity plays an important role in this effect since under recurring costs, consumers repeatedly "book" the most valued units, while under one-time costs consumers tend to experience less return to scale.

Together, the two essays suggest that contracts involving recurring financial events are mentally represented differently from those with one-time financial events, and that content is then discounted based on intertemporal preferences.

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Dedication

For my family.

1

Introduction

On Decisions Across Time

Many consumer financial decisions have consequences that recur over time. For example, mortgages and other contracts involve a discrete set of payments made periodically. Often, consumers' largest financial decisions involve contracts that result in paying or receiving money repeatedly, as many financial products by design enable consumption smoothing and/or committing future income to finance a large purchase today. To properly respond to consumer needs and improve consumer welfare, marketers must understand how consumers evaluate recurring financial events.

Life cycle models of consumption in standard economic theory generally assume that consumers will treat a contract with recurring financial events, such as a mortgage, as equivalent to its net present value as a one-time event (Lambrecht and Tucker 2012). For example, Campbell and Cocco (2003) model consumer mortgage choice by optimizing the discounted lifetime consumption subject to income constraints. However, consumers generally respond differently to one-time financial events and recurring financial events in predictable ways. First, consumers generally do not spontaneously combine outcomes when presented with a decision involving recurring financial events (Thaler and Johnson 1990). Second, they tend to separately account for a contract's gain or loss in each period (known as period-level bracketing) rather than integrating all gains and losses of the contract (Lambrecht and Tucker 2012) and this influences choices, for example, by shortening the investment horizon (Bernartzi and Thaler 1995). Conceptually, the difference between one-shot and recurring financial events differs from narrow vs. broad choice bracketing (Read, Loewenstein and Rabin 1998) in that both recurring and one-time financial events involve the full set of consequences, and as such both are broadly

bracketed. This dissertation further explores how consumers evaluate recurring financial events under period-level bracketing.

In certain ways, all financial decisions involve recurring financial consequences. Some, such as mortgages, carry explicit financial consequences, but even one-shot financial events have consequences over time, as a dollar spent today is unavailable tomorrow. However, in the latter case consumers often ignore these implicit costs (Frederick et al. 2009) so this dissertation is primarily concerned with financial decisions involving explicit series of financial events. In this regard, recurring financial events differ from one-time financial events due to two characteristic features: First, in recurring financial events, some events occur later than other events in the series, and second, recurring financial events divides an equivalent one-time financial event into multiple events. To the extent that consumers think about opportunity costs of one-shot costs as affecting the future, the insights from this dissertation on recurring financial events are generalizable to all financial events.

Extant theories make opposing predictions about consumers' attitudes toward recurring financial events. The hedonic editing principles associated with Prospect theory suggest that consumers should prefer to segregate gains and aggregate losses (Thaler 1985). Yet if consumers discount future events (Samuelson 1937), segregating gains has the potential to delay (and hence discount) positive events, and aggregating losses has the potential to accelerate (and hence exaggerate) losses. The empirical evidence suggests that consumers often prefer to separate gains or losses over time[1] (Thaler and Johnson 1990; Linville and Fischer 1991) and prefer increasing to decreasing series of incomes (Loewenstein and Sicherman 1991).

[1] While consumers at times prefer to combine losses with gains when the gains can cancel losses, they tend to prefer separate gains (losses) to combined but otherwise equivalent gains (losses).

This dissertation first explores how consumers evaluate recurring financial events by applying recent advances in the behavioral discounting literature to the domain of mortgage choices. Standard economic models typically assume a low intertemporal discount rate, close to that of the interest rate, in normative models of consumer behavior. However the research on temporal discounting typically finds much higher rates of year-over-year discounting – findings showing that a given asset loses 20-30% (or more) of value per year of are not uncommon (Hausman 1979; Harrison et al. 2002). Additionally, abundant evidence suggests that dynamic inconsistencies in inter-temporal preferences (i.e. declining discount rates over time, such as that of Laibson's quasi-hyperbolic discounting model (1997)) can produce preference reversals (Frederick et al. 2002) due to a present bias, which overvalues events in the present over those in the future. In this dissertation, both essays relate with intertemporal discounting. Essay I extends this literature by investigating the role of individual differences in present bias and exponential discounting on mortgage choices. Essay II is careful to control for the role of intertemporal preferences in order to explore whether recurring financial events and one-time financial events call to mind fundamentally different content.

Second, the financial events themselves do not exist in a vacuum. Before events can be evaluated based on their point in time, the events themselves must be characterized. In this process, financial events are evaluated based on what they bring to mind. Essay I will discuss the importance of the social, moral and conceptual context in which mortgage decisions are made. Essay II will more explicitly test how framing a financial event in aggregate or as a recurring event changes what gets called to mind, in violation of the economic principle of separability. These two essays together indicate that contracts involving recurring financial

events are mentally represented differently from those with one-time financial events, and that content is then discounted based on intertemporal preferences.

In what follows, the first essay examines the relationship between inherent preferences and financial choices involving recurring consequences. Specifically, this essay tests for the relationship between intertemporal preferences, including present bias and a personal (exponential) discount rate, and mortgage choices leading to negative home equity, as well as willingness to strategically default from a home with negative home equity. This domain is of both substantial and theoretical interest, as it both relates with life-altering financial choices made by millions of Americans over the past decade that severely affected the economy, and as a representative financial decision that involved recurring consequences and was influenced by inherent preferences.

That essay reports the results from a survey of mortgaged homeowners that was augmented with third party data about local economic conditions. It utilizes a recently introduced method of eliciting multiple parameters characterizing time and risk preferences that dynamically selects choice alternatives and leverages response heterogeneity (Toubia et al. 2012). Additionally, it estimates a series of regressions and simultaneous equations using 3-stage least squares. These models control for a variety of individual and economic factors and exploring alternate formulations of key parameters as robustness checks.

The second essay examines how contextual factors influence financial choices involving recurring consequences. Specifically, this essay investigates how consumers use payment frequency as a cue about how frequently to "book" nonmonetary consequences associated with the transaction. When price is framed as a frequent event, consumers account for the transaction's benefits more frequently, and they tend to generalize a narrowly-bracketed benefit

to the full transaction. When particular benefits are valued highly, such as in the case of scope-insensitive preferences, more frequent booking can increase purchase intentions.

Methodologically, the second essay reports results from five web-based behavioral experiments, several pretests and supplemental studies. These studies largely build on the pennies-a-day paradigm (Gourville 1998) to isolate how payment frequency influences purchase intentions independently of time preferences. The first study manipulates payment frequency (daily vs. yearly) to see whether participants anticipate that donating to a charity will be more rewarding when the costs are framed narrowly. Through simultaneously estimated equations, this study evaluates whether this happens in addition to, and controlling for, how payment frequency influences perceptions of cost (e.g. triviality). The second study replicates this result for a car lease, a product category with nontrivial costs. The third study also manipulates affective involvement to explore the role of scope insensitivity. The fourth and fifth studies evaluate participants' assessments of particular days and responses to other scales to test various explanations of the effect and address methodological gaps of the previous studies.

The rest of this document is organized as follows. Essays 1 and 2 appear in the next two sections. Following the essays, the final chapter contains general commentary and discussion of future research directions. Together, both time preferences and contextual cues affect consumers' perceptions of recurring financial events. Consumers tend to adopt the period of a recurring financial event as periods to evaluate the overall contract, and then the contract's events are discounted according to time preferences.

2

Essay I:

Time Preferences, Mortgage Choice and Strategic Default

Summary

Mortgage choice is a consequential consumer choice that highlights the role of time preferences in determining outcomes. This essay relates two components of an individual's time preference, a present bias (overvaluing immediate outcomes), and a personal discount rate, to mortgage choice and the decision to strategically abandon a home worth less than its mortgage. An analytic model, a survey of 244 mortgaged households augmented by zip-code market house price data, and a nationally-representative sample of US households together show that consumers with greater present bias and discounting are more likely to choose mortgages that minimize up-front costs and be underwater. The model also suggests that present bias decreases the likelihood of walking away, but higher discounting increases that likelihood, a result consistent with the data. Time preferences remain robust predictors with individual and market-level controls, as well as alternate model specifications.

Introduction

Selecting a mortgage is often the single largest financial choice made by many consumers (Campbell and Cocco 2003), yet these choices have received little attention in marketing (for an exception, see Lee and Hogarth 1999). Mortgage choices are important consumer decisions to study, both because of their significant welfare impact and for theoretical reasons because they involve decisions across time and commitment in the long term. One central factor in mortgage choice involves time preferences: because mortgage choices typically involve commitments of 30 years of payments, it is particularly important to understand how consumers trade off savings and consumption over the long term.

In light of the outcomes from mortgage choices in the last decade, there is reason to suspect that standard economic analysis may not fully explain consumer mortgage choices. Under a typical intertemporal economic model, households select mortgages to optimize their expected lifetime consumption, discounting future events exponentially, that is, by a constant factor for each period of time delay (Campbell and Cocco, 2003). Yet a large number of American homeowners now live in homes worth less than the amount owed on their mortgage (Zillow 2012; Federal Reserve 2012a). Additionally, some homeowners are "strategically" abandoning their mortgage (i.e. defaulting even if they can afford mortgage payments) – or failing to default – against the of counsel of normative exponential discounting models. Both underwater homeownership and strategic default can have a marked impact upon health of the economy as a whole (Federal Reserve 2012b).

This essay applies a different approach to understanding mortgage choices. To better understand these decisions, this essay examines, both analytically and empirically, how behavioral models of time preference (Frederick, Loewenstein and O'Donoghue 2002; Loewenstein and Thaler 1989) influence the choice of a mortgage and the decision to abandon one's current obligation, and demonstrate that the predictions of these models are quite different than those of standard economic analysis. In particular, this essay applies to mortgage choice a model with two components of individual time preference: first, the exponential discount rate of extant models of mortgage choice, and second, a present bias, which is the tendency to overvalue immediate outcomes (Phelps and Pollack 1968; Laibson 1997).

This essay proposes that individual differences in time preferences explain an important part of the related decisions to buy and maintain a mortgage. Past research has found that present bias relates explains job search behaviors (DellaVigna and Paserman 2005), and that

individual differences in time preference are an important predictor in many life outcomes including smoking, body-mass index, savings towards retirement, and credit card debt (Chabris et al. 2008; Reimers et al. 2009). In the domain of mortgage choice, this essay proposes and finds that while exponential discounting has a main effect to produce mortgage choices that undervalue later outcomes relative to earlier outcomes, present bias places homeowners at greater risk from negative housing market shocks both in mortgage choice and abandonment.

In housing decisions benefits typically precede costs, while in contrast, abandoning mortgages often has the reverse profile. As an analytical model will show, exponential discounters and present-biased homeowners are more likely to accept back-loaded mortgages that place them at greater risk of becoming underwater following negative home price shocks. However, the two types of discounting have different effects on the decision to default once underwater. Exponential discounters will walk away because neither the promise of a fully-owned home in the distant future nor the immediate pain of moving outweigh the fact that rent costs less than their mortgage payment. In contrast, present biased homeowners will continue to make mortgage payments because the short-term costs associated with losing the home and moving are prohibitive.

Focusing on more behaviorally informed models and individual differences may be important for three reasons: First, misunderstanding time preferences may have contributed to the current crisis by encouraging consumers to become more highly leveraged in a single sector of the economy and thus more exposed to negative housing market shocks. Second, understanding time preferences may help design successful interventions by structuring incentives most likely to appeal to underwater homeowners considering whether to default on their mortgage contracts. Finally, understanding time preferences can shed light on all household

financial choices that involve streams of expenditures and consumption over time such as retirement savings, wealth decumulation and others. In that sense, mortgage choice is a useful context to understand the implications of time preferences across a wide range of consumer financial decisions.

Time Preference and Mortgage Choice: An Illustration

To provide an intuition for the approach, consider models that propose that there are two components of individual time preference: a present bias (a tendency to overvalue immediate outcomes) and an exponential discount rate for outcomes beyond the present. To develop the hypotheses, one can compare the behavior of these quasi-hyperbolic (Phelps and Pollak 1968; Laibson 1997) consumers to that expected from a standard exponential model--the key difference between the models is the presence or absence of a "present bias." (For other analytical work in marketing that applies behavioral models of time preference in consumer behavior see Zauberman (2003) who applies the concept to explain lock-in, Gilpatric (2009) who develops an analytical model to explore its effect on mail-in rebates, and Machado and Sinha (2007) who apply it to smoking cessation. Time-inconsistent discounting has also been explored in the marketing literature by Prelec and Loewenstein (1997) who discuss the implications of declining impatience over time (Ainslie 1975) and Lambrecht and Tucker (2012) who discuss time period-level bracketing in contract choice.) Since it is important to understand and control for market effects and other kinds of individual differences, the empirical analysis models the effect of real estate prices, liquidity, risk attitude, loss aversion, financial literacy, social contagion, and moral beliefs in addition to time preferences. Because the size of present bias and discounting will

affect choice, this essay examines how individual differences in both present bias and the exponential discount rate affect choice.

One mortgage contract (see Carroll et al. 2009; DellaVigna and Malmendier 2004 for models of optimal contract design for present biased consumers and Prelec and Loewenstein (1998) illustrate how to optimally time and link payment and consumption events), the "2 and 28" mortgage (Mayer, Pence and Sherlund 2009), is a hybrid of an initial 2-year fixed-rate mortgage and a 28-year adjustable. It has an low initial rate (for example, 7.25 percent) that becomes much higher at the end of the 2-year introductory period, for example 11.81 percent, set according to the London Interbank Borrowing Rate (LIBOR) and includes a premium (typically 5.975 percent) (Johnson and Mayer 2011). For example, in June of 2005, a $250,000 mortgage would have initial payments of $1,705.44, which increased to $2,507 in the twenty-fifth month. These mortgages are very attractive in the short term but not the long term. Many other mortgage instruments have similar intertemporal characteristics, and move debt to latter periods, including refinancing one's home to recover equity, home equity loans, and interest-only adjustable-rate mortgages.

From the lender's perspective, these mortgages perform an important function. There is considerable uncertainty about some borrowers' ability of to repay loans, particularly those (subprime) with low credit ratings. The logic behind a 2/28 loan was that the large payments that follow the first two years would ensure that it would appeal to only those who are willing or able to improve their credit ratings. The argument in standard economics is that after two years of making payments and with their improved credit score, these more trustworthy borrowers would refinance into better loans. Thus 2/28 mortgages were seen as a tool that allowed consumers to repair or establish their credit, and allowed lenders to protect themselves against adverse

selection because only potential prime borrowers would select this mortgage (Mayer, Pence and Sherlund 2009). More generally, a decade ago, subprime mortgages like the 2/28 mortgage seemed to offer a promising route to home ownership to those unable to qualify for traditional mortgage financing. Of course, this is not what happened. The promising alternatives such as 2/28 mortgages have turned out to be a nightmare, for both lenders and homeowners.

While unscrupulous or overly optimistic borrowers and lenders played a role in the mortgage crisis, behavioral models of time preferences may also help explain the choices made by consumers and mistaken judgments made by banks. Mortgages like the 2/28 were particularly appealing to present-biased individuals because they presented lower upfront costs in return for greater later costs. In fact, these mortgages did not protect lenders against adverse selection, but instead were magnets for present-biased borrowers, who are inclined to utilize alternative financial vehicles for immediate gain at the expense of future fallout. The model also suggests present-biased people are less likely to say they will walk away from their underwater properties, again a result not apparent in a standard model. The intuition behind this argument is that more present-biased people will overweight the immediate costs of moving such as finding a rental, removing children from schools, etc.

The remainder of this essay is organized as follows: First, it reviews a traditional economic analysis of mortgage choice. It then discusses three behaviorally informed and model-based hypotheses about mortgage choice and abandonment. Third, it describes a data set combining both commercial market data and the survey responses of 244 households, of whom half were underwater. The data suggests that both present-bias and high rates of exponential discounting are associated with owing more on a mortgage than the underlying value of the home. This result is robust to a number of statistical controls. In strategic defaults, present bias

seems to decrease the reported intention to default on underwater mortgages even when to do so would be financially advantageous.

Modeling Consumer Mortgage Choice

Mortgages allow consumers to move from rental housing to housing that they will eventually own. Standard economics describes the mortgage choice as an optimization problem conducted with expectations of future consumption and wealth. For example, Campbell and Cocco (2003) model the choice between a fixed rate and an adjustable mortgage for households (indexed by *j*) that maximize an objective function capturing the expected lifetime flow of discounted consumption:

(I-1) $$E_{t=0}\left[\sum_{t=0}^{T}\delta^{t}\frac{C_{jt}^{1-\sigma}}{1-\sigma}+\delta^{T+1}\frac{W_{j,T+1}^{1-\sigma}}{1-\sigma}\right],$$

subject to household j's income constraints, an exponential discount rate (δ), a coefficient of relative risk aversion (σ), expected consumption amount *(C)* in each time period (*t)*, and terminal real wealth (*W*).[2] These are summed over *T* time periods representing the expected lifetime of the individual. Campbell and Cocco (2011) model mortgage default using a similar model. With exponential discounting and constant relative risk aversion, this functional form is typical of standard economic life-cycle models for savings and investing in general, and of mortgage choice in particular. But what if consumers do not use an exponential discount function? Based on the growing empirical evidence suggesting non-exponential discounting, a quasi-hyperbolic form, provides additional insight into consumer mortgage decision-making.

[2] Campbell and Cocco refer to δ and σ as β and γ, respectively, but the variables are labeled differently here for consistency with notation from Prospect theory and quasi-hyperbolic discounting.

Experimental studies of time preferences typically present respondents with choices between a smaller-sooner reward and a larger-later reward. The choice options are represented as *(x, t)*, meaning a reward *x* that is consumed at time *t*, or *t* periods (e.g., days or years) from now. The standard model is Discounted Utility, $U(x,t) = v(x)d(t)$, and assumes that the discount function, $d(t)$, is exponential. This assumes the same proportion of *x* is discounted each time period. An alternative, hyperbolic discounting, implies a discount rate decreasing with time, as often observed in behavioral studies. The quasi-hyperbolic discount function (QTD, Angeletos et al. 2001; Benhabib, Bisin and Schotter 2010; Laibson 1997) mimics a hyperbolic or decreasing discount function by placing more weight on the initial period.

Using the QTD model, time preferences are modeled with the form:

(I-2) $$U(x,t) = v(x)d(t), \text{where}$$

$$d(t) = \begin{cases} 1 & \text{for } t = 0 \\ \beta\delta^t & \text{for } t > 0 \end{cases}.$$

For $\beta < 1$, the discount function presents a discontinuous drop at $t = 0$, which reflects the empirical observation that delays diminish a present event's importance more than delaying events at any future $t > 0$. This represents *present bias* (O'Donoghue and Rabin 2001). This approach may be extended to other functional forms, but this essay focuses on quasi-hyperbolic discounting here for simplicity and ease of measurement. The discount factor, δ, corresponds to the individuals' exponential discount rate.

A hallmark of behaviorally based models of time preference like QTD, is that they predict inconsistent choices across time: things that are attractive now, because of present bias, are regretted later, and conversely consumers agree to unattractive future outcomes, such as increased costs, but because of present bias, find them much more onerous when they come due (Kirby and Herrnstein 1995). This can be detrimental in many ways. For example, opportunistic

firms could exploit consumers' QTD preferences by initially pricing low and inflicting heavy switching costs as well as back-loading fees (DellaVigna and Malmendier 2004). Similarly, theoretical analysis suggests that given QTD preferences in the credit market, present-biased consumers suffer welfare losses after over-borrowing and enthusiastically adopting credit arrangements that are inexpensive in the short-run but inflict expensive default penalties following inevitable repayment delays (Zauberman 2003; Heidheus and Koszegi 2010).

This inconsistency has strong implications for dynamic decisions occurring across time. DellaVigna and Paserman (2005) examine job search among the unemployed and demonstrate analytically that present bias decreases search because the pain is immediate, yet impatience increases their likelihood of taking a low paying job, because the long term consequences of taking a low wage job are underweighted. Thus present bias keeps people from searching, but when they get an offer, they settle for low wages. Present bias may also have implications for public policy: Paserman (2008), for instance, finds that optimal unemployment benefit and job search policy dramatically changes after accounting for present bias, in some cases leading to 40% changes in policy impact.

The present research builds on this literature by exploring the effect of present bias and an exponential discount rate on decisions that may lead to negative home equity and how these factors influence homeowners' willingness to walk away from a home asset. Much like the literature examining hyperbolic discounting in dynamic decisions, this essay argues that present bias and exponential time discounting will have very different effects on these two decisions.[3] Recent work also links present bias with overconfidence, in particular with the optimistic

[3] To narrow this essay's focus, it simplifies one important aspect of time preferences, the behavior of 'sophisticated' present-biased agents who enter into contracts to exert self-control. Since there does not exist a method of empirically evaluating sophistication, this essay assumes that present-biased consumers are not forward-looking.

evaluations of future outcomes (Heidhus and Koszegi 2010; see also DellaVigna and Malmendier 2006), and liquidity constraints (Meier and Sprenger 2010). Thus what appears to be present bias may be exacerbated or even caused by unseen constraints, rosy predictions of future income or exercise behavior. These issues will all be addressed later through alternate model specifications.

Time Preferences, Mortgage Choice, Negative Equity and Strategic Default

A QTD model suggests that homeowners' mortgage choices depend on how incentives (financial or otherwise) are distributed across time. This section outlines the specific predictions of how time preferences relate with underwater homeownership and strategic default. It will first discuss how present bias (a lower value of β) and exponential discounting (a lower value of δ) affect evaluation of mortgage features. It will then turn to how those mortgage features do not share an equal risk that negative housing market shocks will result in negative home equity. Finally, it will elaborate on the relationship between time preferences and strategic default. All of these predictions are expanded upon more formally in Appendix I-A.

Time Preferences and Evaluations of Mortgage Features

A QTD model suggests that more present bias will cause decision-makers to overweight consequences in the present relative to those that they expect to occur later. In particular, those with more present bias tend to maximize immediate gains while underweighting future consequences such as higher later payments. For example, present-biased individuals will prefer mortgages with lower initial rates and smaller or no down payment, such as the 2/28 mortgage discussed earlier.

Similarly, differences in discounting as measured by an exponential discount rate (a lower value of δ) also affect the attractiveness of mortgage options. To be more specific about the effect of exponential discounting, note that higher discounters will want to accelerate gains and delay losses as compared to more patient decision-makers. Thus, the effect of exponential discounting on the attractiveness of a mortgage will depend on the timing and size of the stream of gains and losses for the specific mortgage options presented to a consumer. It will diminish the importance of distant-future payments more strongly than near-future payments, specifically, by the fraction δ for each year separating the payments. This can encourage homeowners to defer repayment, even in the absence of present bias, if they discount future events by more than their expectations about the real interest rate.

These intuitions about present bias and discounting have implications for mortgage choices leading to being underwater. A logical consequence of appendix equation I-A3 is that, in selecting mortgages, both greater present bias and discounting encourage consumers to delay payments and to seek larger houses in the immediate and short term in favor of committing to making larger payments later. This leads to Hypothesis I-1:

Hypothesis I-1: *Present-biased and exponentially discounting agents (low* β and δ*) select more mortgages that enable them to delay payments than patient agents.* For example, agents with $\beta < 1$ or $\delta < 1$ will back-load mortgages more willingly than agents with $\beta = \delta \approx 1$.

Time Preferences and Underwater Mortgages

A mortgage is said to be said to be underwater when the mortgage debt exceeds the market value of the home. Consequently, if present-biased and exponential discounters have

more back-loaded mortgages, at any given point in time they owe more on their mortgage than patient homeowners. Consequently, as negative housing shocks erode property values, the home value falls below the mortgage debt of present-biased or exponentially discounting homeowners before the home value falls below patient homeowners' mortgage debt. Thus homeowners who exhibit present bias and exponential discounting are more likely to be underwater. This is Hypothesis I-2.

Hypothesis I-2: *The mortgages selected by impatient agents (low* β and δ*) are more likely to become underwater following negative housing market shocks because back-loaded mortgages are repaid more slowly than front-loaded mortgages.*

Time Preferences and Strategic Default

As indicated by appendix equation I-A7, present bias and discounting have opposing implications for strategic default. Walking away carries future consequences, such as the loss of the residual value of the home after mortgage payments have been made, which discounters find less unattractive. In contrast, present-biased homeowners find staying in the home to be more attractive because they overweight negative immediate term consequences (such as social stigma and experiencing negative affective reactions of the loss of one's home) and underweight positive medium-term consequences of moving (such as reduced housing payments). Consequently, appendix equations I-A4 through I-A8 derive opposite predictions for how present bias and discounting relate with strategic default.

Hypothesis I-3: *Homeowners who exponentially discount the future more (low δ) are more likely to default on their mortgages while present-biased homeowners (low β) are less likely to default.*

Appendix I-A contains a formal derivation of these predictions in a simple model of mortgage choices.

Method

Data

To examine these questions, this essay analyzes a data set that includes both responses to a survey of mortgage holders and market-level real-estate variables provided by commercial services. Survey data is increasing being used in the study of consumer finance (Graham and Harvey 2001). There are potential problems with framing of survey questions, but survey data allows direct assessment of individual-level characteristics such as time preferences and knowledge, as well as to measure intentions to walk away from a mortgage. While alternatives exist, such as structural modeling, the levels of negative equity that present in the current environment have no equivalent in recent past data. Any attempt to understand the current crisis would have to wait years until the consequences are observed. Other studies have shown a broad effect of measured time preferences on behavior including credit card usage and savings (Meier and Sprenger 2010; Chabris et al. 2008; Reimers et al. 2009). The latter form of data, market-level real-estate variables, has the advantage of being based on administrative records of actual sales but is usually only available at the level of the zip code.

Survey

Between April 15, 2010 and May 2, 2010, an Internet survey collected data from 244 mortgaged US homeowners, of which were 120 underwater and 124 had positive equity. These individuals were drawn from a panel of 44,000 research volunteers maintained by Columbia's Center for Decision Sciences. By completing a screening questionnaire embedded in other studies, 750 potential participants confirmed that they owned a home in the United States and had a nonzero mortgage debt. Five hundred received an invitation to participate in this study. Those who indicated that they owed more on their mortgage than the current market value of their home were oversampled in order to achieve a roughly even split of underwater and non-underwater homeowners. Homeowners answered a series of questions about themselves, their home and their financial status. The survey collected information about individual differences in evaluation of prospects, present-biased time preferences, participants' debt literacy, and cognitive reasoning. Participants were compensated $12 for their time, plus other rewards that made the time preference assessment incentive compatible.

Participants began by reading a passage orienting them to concepts and terminology surrounding underwater mortgages and the choice of whether to walk away, which was similar to the information commonly available to homeowners through mainstream media sources. Specifically, to identify the relationship between time preferences and walkaway choices, participants considered a choice between two clear, if simplified, options: (1) moving into a rental unit in their area and allowing the bank to foreclose on the house, or (2) staying in their current house and continuing mortgage payments.

Their answers provided the "walk-away value," the dollar amount to which the home would need to fall for a given respondent to walk away from the mortgage. These values were

elicited through an adaptive titrator, which asked a series of binary questions about whether the respondent would stay or walk away if their home's market value changed to a specific value determined by prior responses. The titrator was calibrated to each subject's current home market value (as reported at the outset of the survey), and the range of possible walk-away values was considered to be between 0 and 120 percent of their current home value (see Guiso et al. 2010 for a similar measure). In each round, subjects responded with whether they would move out and stop paying their mortgage at that home value. After each round, if they indicated a willingness to stay (default) at a particular home value, the ceiling (floor) walk-away value was reduced by 42% of the range of values. This process repeated until it achieved sufficient specificity, which occurred when the range of potential values was reduced to below 5% of their current home market value.[4]

Respondents then answered a series of questions about their financial position and demographic factors, including, age, gender, marital status, number of children, and education. Financial factors included employment status, income, monthly mortgage payment, years since the home was purchased, current mortgage debt, the initial cost of the home, and their self-assessment of their underwater status. Income and monthly mortgage payment were combined to produce the share of income servicing the mortgage. While some researchers have expressed concerns that individuals cannot recall mortgage details (Bucks and Pence 2008), these respondents' assessment of their home equity and debt were largely internally consistent with their other responses in the survey and correlate strongly with zip code-level averages obtained from Zillow.com. This data contained average home sale prices at the zip code level both in the

[4] The range constricted by 42% each round to ensure efficient convergence to an individual-level walk-away price estimate while permitting response uncertainty. The adaptively elicited value was validated by directly asking respondents their walkaway price. The measures correlated 0.99.

year the home was bought (for years since 2000) and around the time of the survey. Mean zip code-level home prices correlated 0.47 with respondents' self-reported home prices. To further ensure data integrity, data were dropped from a limited number of observations that provided wildly inconsistent answers to housing equity questions. Additionally, respondents answered a three-item debt literacy scale and financial competency self-assessment of Lusardi and Tufano (2009) and a three-item cognitive reflection task (Frederick 2005) and asked about the mortgage type.

At the end of the survey, two adaptive tools enabled estimation of individual-level parameters for quasi-hyperbolic time discounting (QTD) (Laibson 1997) (β, δ) and cumulative Prospect theory (CPT) (α, λ, σ) (Tversky and Kahnemann 1991; Prelec 1998). Time preferences (β, δ) were estimated with each time period corresponding to a day, so a payment delayed one day is diminished by the discount fraction βδ, and a one-week delay induces a discount fraction $\beta * (\delta \text{^} 7)$. For a full discussion of this adaptive, method and its Bayesian estimation procedure, including validity checks of the estimation of discounting and Prospect-theory parameters, see Toubia et al. (2012).[5] One in one hundred participants were randomly selected to receive the outcome of one of their choices.

Each segment began with an introduction to the task and a set of questions verifying comprehension. To estimate quasi-hyperbolic discounting parameters $\{\beta, \delta\}$, subjects chose from 20 pairs of possible payments at different points in time, in some cases including the present day. Similarly, to estimate CPT parameters $\{\alpha, \lambda, \sigma\}$, respondents reviewed 16 pairs of two outcome mixed gambles and asked respondents to indicate their choice. In each case, questions were

[5] Though previous research finds that time preference elicitations risk being confounded with trust in the experimenter, there is no reason to suspect that trust in the experimenter would influence relationships between time preferences and mortgage choices.

selected adaptively to decrease the variance on estimation of the decision-maker's vector of parameters. To make the individual difference-parameter estimates incentive-compatible, one out of every hundred respondents received a supplementary payment corresponding with their answer to one of the elicitation questions. After the task, participants learned whether they were selected, and were paid the same day. Individual-level estimates of quasi-hyperbolic discounting and Prospect theory parameters were produced through hierarchical Bayes' models incorporating responses across subjects for each component.[6] While the parameters β, δ were estimated with error terms, only the point estimates (rather than the associated error) were used in subsequent analysis.

Control Variables: Risk, Differences in Ability/Knowledge, and Financial Status

Risk attitude has a central role in standard models of mortgage choice (see equation I-1), so assessment of individual attitudes toward risk could be potentially helpful in understanding mortgage choice. It has also been argued that the observed high levels of discounting may be related to high levels of risk aversion (Andersen et al. 2008). The present research assesses risk preferences and time preferences simultaneously, allowing the results to control, for example, the degree of risk aversion in looking at the effects of time preferences as well as observing direct effects of risk attitude upon mortgage choice and abandonment.

This essay uses a standard Prospect-theory framework and the probability-weighting function proposed by Prelec (1998) with a set of adaptively generated options. Value for a choice option is described by three parameters $\{\alpha, \sigma, \lambda\}$, which capture, respectively, the distortion (nonlinear sensitivity) of the probabilities, the curvature (sensitivity) of the value function, and

[6] The fit of the QTD model was compared to both a hyperbolic and an exponential model to respondents' choices, and the QTD model was found to have a significantly superior fit.

loss aversion. Genovese and Mayer (2001) demonstrate the importance of loss aversion in real-estate decisions.

There has been an increasing interest in the impact of cognitive and knowledge differences on consumer financial decisions. This essay uses measures of cognitive reflection (Frederick 2005) to assess cognitive ability.

Another source of differences in ability is preexisting knowledge. Lusardi and Tufano (2009), among others, have documented large differences in financial and debt literacy, relating them to the quality of financial decisions that people make. The current study uses Lusardi and Tufano's (2009) measure of debt literacy as a control.

Mortgage choice will also be affected by individual differences in economic status such as income and credit status. It is also quite plausible that economic status could be determined by time preferences. Analysis will therefore control for these variables in relating time preferences to being underwater or intentions to abandon a mortgage.

Market-Level Variables

In addition to individual characteristics, market-level outcomes affect being underwater and walking away. Two sources of data control for market-level shocks. The first, provided by Zillow.com, contains estimates of the current median home price, the price when the home was purchased, and its price at the peak of the market at the level of each homeowner's zip code. Zillow prices have been widely used by real estate economists (e.g. Mian and Sufi 2009). To control for current market-level conditions at the zip code level, BlackBox Logic LLC provided the percentage of homes that are currently being foreclosed, and the percentage that are involved in short sales. BlackBox tracks 90% of privately securitized US mortgages originated between

2000 and 2009. For both data sets, there were occasions (respectively, 25 and 7 percent) when zip code data were not available. In these cases, missing zip code data was replaced by available state-level data, which had a high correlation with zip code-level data.[7] To summarize, differences in individual level time preferences are examined as correlates of the type of mortgage selected, the likelihood that a mortgage is "underwater," and the likelihood of defaulting on an underwater mortgage. In particular, the a greater degree of "present bias" in time preferences is hypothesized to be associated with more back-loaded mortgages, greater likelihood of being underwater, and less likelihood of strategically defaulting on an underwater mortgage.

Results

The results are organized as follows: First basic statistics for the measures are presented. After discussing the analysis strategy, the first essay's first research question is addressed: What is the relationship between present bias and exponential discounting and a number of precursors to underwater status, such as a household taking an adjustable-rate mortgage? Then this essay examines the characteristics of a decision-maker that leads them to be underwater. The focus is on time preferences but also controls for value and risk, cognitive abilities and knowledge, and various demographic variables. Finally, time preference and other factors are related to underwater homeowners' willingness to walk away from paying their mortgage. The validity of the measures of underwater status are examined closely, as well as the effects of alternative specifications of present bias, and alternative explanations of the results are discussed.

[7] Correlations between state- and zip code-level data were, respectively, 0.59 for Zillow.com data, 0.78 for BlackBox foreclosure data, and 0.51 for BlackBox short sale data. The analysis excludes a few subjects who provided invalid zip codes.

Descriptive Statistics

Table I-1 provides descriptive statistics (mean and standard deviations) for the measures.[8] It is separated for each group of measures by mortgage equity status. People classified as underwater owe, on average, $14,368 on their home more than its current value, or are approximately 5.3 percent underwater. In contrast, positive equity homeowners' homes are valued at $110,474 (38%) more than their debt.[9] Time preference, value, and risk parameters are comparable to prior studies using different, non-adaptive techniques and different samples (see Toubia et al. (2012) for a more extensive discussion). To compare the sample from the study with the larger population of US homeowners, the respondents were compared to a representative sample of US households gathered in 2010 by a market research company, Strategic Business Insights (SBI). SBI's MacroMonitor survey is, in turn, validated through the Survey of Consumer Finances and the Flow of Funds report by the US Federal Reserve's Board as well as internal wave-to-wave validation. The characteristics of the sample from the study were compared to those from the SBI sample that carry mortgage debt. The final column of Table I-1 suggests that the sample is reasonably similar to the nationally representative sample. The two have similar home values, but the SBI respondents have smaller mortgages, have owned their homes longer, are older, are less educated and have greater loss aversion. These differences may have resulted because SBI over-sampled affluent households while the present study over-sampled underwater homeowners and was conducted online[10].

[8] Descriptions, sources and levels of all variables are contained in Table I-A1. Table I-A2 contains a correlation matrix of the main variables of interest. Both of these matrices appear in Appendix I-B.

[9] The asymmetry in net home equity position among underwater and positive-equity homeowners may reflect, in part, that homeowners tend to become underwater only through negative housing market shocks, while homeowners can gain positive equity both by positive housing market shocks and through years of mortgage payments.

[10] The differences in loss aversion between the samples may be because SBI calculated loss aversion alone while the main survey jointly estimated loss aversion, probability weighting and diminishing sensitivity.

Table I-1. Descriptive Statistics, by Home Equity and Comparable Values of a National Sample.

Mean St. Dev.	**Under Water (n=120)**	**Positive Equity (n=124)**	**Total Sample (n=244)**	**SBI Respondents with Positive Mortgage Bal.**
A. Demographics				
Age	37.8 (8.38)	41.7 (12.5)	39.8 (10.8)	50.6 (13.5)
% Male	0.37 (0.48)	0.31 (0.47)	0.34 (0.47)	0.47 (0.50)
% White	0.78 (0.42)	0.85 (0.35)	0.82 (0.39)	0.78 (0.41)
% With Bachelor's Degree	0.64 (0.48)	0.70 (0.46)	0.67 (0.47)	0.43 (0.50)
% With Graduate Education	0.32 (0.47)	0.23 (0.42)	0.27 (0.45)	0.16 (0.37)
B. Real Estate Characteristics				
Current Home Value	$268,806 (221,719)	$285,916 (218,111)	$277,507 (219,586)	$250,216 (213,790)
Home Purchase Price	$335,917 (372,531)	$295,242 (380,807)	$315,246 (376,536)	
Initial Mortgage Size	$326,042 (479,440)	$249,032 (445,623)	$286,906 (463,218)	$161,049 (128,719)
Amount Paid To Date (Home Cost – Curr. Debt)	$21,509 (126,364)	$85,777 (250,177)	$54,053 (291,112)	
Years Since Purchase	7.09 (4.75)	8.43 (6.18)	7.77 (5.55)	11.27 (10.26)
C. Time Discounting and Prospect Theory Risk Parameters				
β: lower values suggest more present bias	0.84 (0.18)	0.91 (0.10)	0.88 (0.15)	
δ: lower values suggest more exponential discounting	0.37 (0.27)	0.49 (0.25)	0.43 (0.27)	
λ: Higher values mean more loss aversion	2.24 (1.10)	2.28 (1.02)	2.26 (1.06)	4.48 (0.13)
α: Prob. Weighting	0.73 (0.29)	0.76 (0.29)	0.74 (0.29)	
σ: Lower values mean more risk aversion/diminishing sensitivity	0.64 (0.29)	0.65 (0.27)	0.64 (0.28)	
D. Knowledge / Cognitive Resources				
Cognitive Reasoning (CRT) Scale (0-3)	1.13 (1.09)	1.15 (1.08)	1.14 (1.08)	
Debt Literacy (0-1)	0.37 (0.22)	0.42 (0.22)	0.39 (0.22)	

Estimation

The present research is interested in how time preferences have separate influences on mortgage choices related to underwater status and the decision to strategically default on the mortgage. The estimation challenge is that home equity position is related to underwater status and is a strong predictor of strategic mortgage abandonment. Since home equity status influences willingness to walk away, two simultaneous equations were estimated using the three-stage least squares procedure developed by Zellner and Thiel (1962).[11] This provided an estimate of the relationship between time preferences and underwater status, and independently of home equity position, the relationship between time preferences and walking away. The reduced-form equations characterizing the mortgage choices leading to underwater status and willingness to walk away for individual *i*, are:

(I-3) $$underwater_i = \beta_0 + \beta_{u1} * beta_i + \beta_{u2} * delta_i + \varepsilon_{ui}$$

(I-4) $$walkaway_i = \beta_0 + \beta_{w1} * beta_i + \beta_{w2} * delta_i + \beta_{w3} * posequity_i + \beta_{w4} * negequity_i + \varepsilon_{wi}$$

In other words, an individual homeowner's underwater status, $underwater_i$, is a function of present bias (β_i) and exponential discounting (δ_i), while the homeowner's willingness to walk away is a function of their time preferences and their degree of positive or negative equity. Note that $posequity_i$ and $negequity_i$ are expanded forms of $underwater_i$, focusing respectively on the amount of home value in excess of, or shortfall relative to mortgage debt. Consequently, error terms ε_{wi} and ε_{ui} are correlated, and as ε_{ui} influences $underwater_i$, under simple OLS regression, $posequity_i$ and $negequity_i$ are not independent of ε_{wi}.

[11] Independent OLS regressions are not appropriate as the residual from equation I-3is a significant predictor if inserted into equation I-4 (p<0.03). The 3SLS estimates are not materially different from seemingly unrelated regression under this system of equations.

Consequently, OLS regression would produce biased estimates and the equations were estimated simultaneously through 3SLS.

The simplest model simultaneously estimates the relationships between the individual time preferences (β_i and δ_i) and the endogeneous mortgage factors, $underwater_i$ and $walkaway_i$. As there are at least as many factors exogenous to the model as endogenous factors being estimated, $underwater_i$ and $walkaway_i$ are identifiable.

The relationship between present bias, exponential discounting, underwater status and walking away were further tested by adding additional control variables to the model. Both individual difference survey items and independent data on zipcode-level local real estate factors are added successively to each equation. These alternate specifications provide more information to identify the endogenous factors while also helping to address alternate accounts of the relationships found.

All successive equations control for local real estate fluctuations and liquidity constraints that limit the individual's available options. For this equation I-3 the fractional change in local housing prices and mortgage burden to the household's budget. Similarly in all cases, equation I-4 includes local real estate foreclosure and short sale trends and mortgage burden. Beyond these additional controls added to all models, Model 2 includes mortgage year intercepts in both equations, while Model 3 considers debt literacy as a precursor to underwater status as well as social and moral considerations in the decision to walk away. Model 4 examines the potential confounding effects of risk preferences in each equation, while Model 5 includes employment security and cognitive reasoning in each equation, plus expectations about and confidence in the local housing market in the walkaway equation. The next section discusses the results from the

simultaneously estimated equations testing the relationship between time preferences and both mortgage choices.

Antecedents to Underwater Status and Time Preferences

First Hypothesis I-1 is tested to examine the direct effect of time preferences upon mortgage choice. These choices are examined separately from the simultaneous estimation framework because the data contain only self-reports of these decisions and do not have contemporaneous market level controls. The existence of a relationship will be intriguing, but will be subjected to a more rigorous analysis with the tests of Hypotheses I-2 and I-3. This section will overview the relationship between time preferences and the mortgage choices that leave homeowners more at risk of negative home equity following housing shocks. It will first explore these relationships among the sample of mortgaged homeowners, and then turn to similar analyses among a nationally representative sample.

Survey of Mortgaged Homeowners. Hypothesis I-1 suggests that mortgage-related decisions involving the acceleration of benefits and the delay of costs will be associated with present bias. Respondents reported how much of the cost of their home was borrowed, whether they had a fixed or adjustable mortgage, a second mortgage, and the size of their burden of mortgage debt relative to their income. While these data lack the market level controls needed for modeling these decisions jointly with subsequent decisions, an examination of these self-reports of past decisions is instructive.

Present bias is linked with several precursors to negative home equity, as shown in Table I-2. Homeowners with stronger present bias are more likely to have borrowed a larger portion of the cost of their home (p=0.001) and are more likely to have an adjustable mortgage (p=0.006).

Stronger present bias also is associated with a greater likelihood of having a second mortgage on the home (p=0.034), and with spending a larger fraction of income paying the mortgage (p=0.035). In contrast, exponential time discounting is generally unrelated to the underwater antecedents (p's > 0.15).

Nationally Representative Sample. A similar analysis on SBI's nationally representative MacroMonitor data set provides further evidence about the relationship between time

Table I-2. Antecedents to Negative Home Equity and Intertemporal Preferences

	% of Home Cost Borrowed (regression)	**Mortgage Type (Fixed Rate=0, Adjustable Rate=1) (logit)**	**Second Mortgage (logit)**	**Share of Income Servicing Mortgage (regression)**
The Survey Sample of Mortgaged Homeowners				
Present Bias (1-β)	0.429*** (0.129)	2.995** (1.097)	2.260* (1.066)	0.151* (0.071)
Exponential Discounting (1-δ)	-0.038 (0.072)	0.287 (0.758)	0.813 (0.608)	-0.052 (0.040)
Constant (Mean Value)	0.897*** (0.017)	-1.583*** (0.175)	-0.707*** (0.140)	0.230*** (0.009)
Adjusted/Pseudo R^2	0.043	0.050	0.041	0.011
Resid. Std. Error	0.261	0.375	0.460	0.144
Observations	244	244	244	239
Mortgaged Homeowners from Nationally Representative SBI MacroMonitor Sample				
One-Year Impatience [(1-β)*(1-δ)]		1.761** (0.672)	1.469* (0.669)	0.093** (0.029)
Constant (Mean Value)		-1.918*** (0.112)	-1.831*** (0.101)	0.211*** (0.006)
Adjusted/Pseudo R^2		0.012	0.009	0.009
Resid. Std. Error		0.241	0.295	0.172
Observations		1992	2257	2201

Note: β, δ centered; logistic/linear regressions. *** p<0.001; ** p<0.01; * p<0.05; † p<0.10.

preferences and the precursors to negative home equity. While the survey does not decompose time preferences into present bias and discount rates, it does allow one to estimate each respondent's yearly discount fraction based on his or her hypothetical choices between $100 today and various sums ($110, $125, $150, $175, $200, $225) in twelve months. Since the present research suggests that these parameters have the similar effects on mortgage choice, this hypothesis can be tested with this single parameter. Each respondent's yearly discount fraction was estimated based on the rate corresponding with the midpoint between the smallest delayed payment accepted and largest delayed payment rejected. A series of survey-weighted and logistic regressions and logistic regressions were run to assess the relationship between this estimate of impatience and the underwater precursors. The data suggests that impatience predicts having an adjustable interest rate (p=0.01), having a second mortgage (p<0.05) and paying a larger share of income toward the mortgage (p<0. 01).[12]

As a robustness check, additional models added a series of controls to the analysis of the SBI data. The first model controlled for loss aversion. The second controlled for demographic factors including income, marital status, gender, age and education. The third controlled for measures of liquidity including checking account balance, savings account balance and credit card balance, each as a fraction of income. A final model controlled for all of these factors. The relationship between impatience and the precursors were generally robust to these controls, directionally consistent and approximately similar in size. The only measures that did not retain usual levels of statistical significance (p<0.05) was the relationship between second mortgages and impatience controlling for demographic factors which remained directionally consistent and marginally significant. One other caveat is that there was an interaction between income and

[12] It was not possible to assess whether impatience predicts the fraction of the home cost borrowed because the SBI MacroMonitor data did not contain respondents' home purchase price.

impatience in predicting the share of income spent on the mortgage suggesting that this particular finding is restricted to the lower income range (income<$50,000). The SBI data set further indicates that impatience predicts net home equity among all homeowners (p<0.0001), a result that retained usual significance after accounting for all controls.[13] All other tests suggest, consistent with the survey, and with Hypothesis I-1, that the impatience predicts precursors to negative home equity.

Underwater Status and Time Preferences

Estimating the effects of time preferences upon both underwater status and mortgage abandonment presents several challenges. Two outcomes were modeled: The first, contained in Hypothesis I-2, is the impact of prior mortgage choice on current equity in the home; the second, consistent with Hypothesis I-3 is the intention to walk away. Since current mortgage status will influence the intention to walk away, the present research simultaneously estimates equations modeling both decisions. That is achieved through a three-stage least-squares regression (Zellner and Theil 1962), which simultaneously estimates the relationship between time preferences and underwater status as well as between time preferences and walking away (controlling for home equity status). Analysis with OLS regressions revealed similar relationships between time preferences and all the outcome measures.

Because market-level real estate shocks to individual financial status also influence consumer mortgage outcomes, the analysis also considers self-reports of liquidity. This control suggests that observed relationships between time preferences and underwater status are not artifacts of short-term financial constraints caused by the home equity outcomes. Finally the

[13] Appendix I-C contains further analysis of the relationship between intertemporal preferences and net home equity, as well as between intertemporal preferences and net worth.

robustness of the results were tested by adding additional controls to the model, including social and moral factors, risk preferences, loss aversion and probability distortion as characterized by Prospect theory, and financial literacy.

While Table I-1 shows simple differences in time preference between underwater and positive-equity mortgagers, consistent with Hypothesis I-2, Table I-3 presents the results of the three-stage least-squares analyses of underwater status with various controls. Model 1 indicates that homeowners with strong present bias (lower β) or who underweight outcomes in future time periods (lower δ) are more underwater. This result persists after accounting for the effects of several descriptors of individuals' economic condition, knowledge and skill, and other preferences as well as market-level events. In the following regressions (see Table I-3), all continuous covariates are mean-centered.

Model 2 and those that follow add two controls. The first, based on data provided by Zillow.com, employs a variable representing zip code-specific real estate market change in price since the property's peak estimated value. This controls for the possibility that the time preference effects are confounded with the choice of the houses or neighborhood or other possible relationships. As expected, this has a significant effect on being underwater. Similarly, entering the proportion of income servicing the mortgage (based upon the respondent's answers to income and mortgage payment questions) is a significant predictor of being underwater, with those devoting more of their income to servicing the mortgage more likely to be underwater. This controls for the liquidity of the household. It might be that households that are strapped for cash become present-biased or that time preferences influence other financial choices that constrain the range of mortgage choices available to the household. However, both present bias and exponential discounting remain significant in the presence of these controls, suggesting that

Table I-3. Which Homeowners Are Underwater?

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Present Bias (1-β)	2.23** (0.85)	1.87* (0.81)	1.98* (0.84)	1.85 (0.83)*	1.75 (0.84)*
Exponential Discounting (1-δ)	0.79* (0.40)	0.95* (0.40)	0.80* (0.40)	0.91 (0.40)*	0.91 (0.40)*
Frac. Change in Local Housing Prices Since Peak / Purchase		-2.60*** (0.55)	-2.08*** (0.56)	-1.95 (0.56)***	-2.14 (0.56)***
Frac. Income Servicing Mortgage		1.43* (0.64)	1.40* (0.64)	1.27* (0.64)	1.40* (0.64)
Debt Literacy			-0.53 (0.42)		
Loss Aversion (λ)				0.04 (0.11)	
Diminishing Sens. (σ)				-0.34 (0.44)	
Prob. Distortion (α)				0.10 (0.32)	
Employment Security					0.09 (0.08)
CRT Scale					-0.06 (0.08)
Constant	0.10 (0.09)	Purchase Year Fixed Effects	0.11 (0.09)	0.18* (0.09)	0.03 (0.11)
R-sq	0.0921	0.2573	0.1667	0.1562	0.1679
N	226	215	215	206	215

Each column contains 3SLS regression coefficients simultaneously estimated with walk-away model, with standard errors in parentheses. *** p<0.001; ** p<0.01; * p<0.05; † p<0.10.

time preferences matter independent of real estate choice and financial demands of the mortgage. Additionally, this model includes fixed effects for each purchase year, which rules out a confound between mortgage year in the relationship between time preferences and underwater status.

Model 3 controls for knowledge about debt, a variable shown to predict the cost of credit card borrowing (Lusardi and Tufano 2009) but which is insignificant in this context. Model 4

adds the three Prospect-theory variables to Model 2 and shows that loss aversion, diminishing sensitivity, and probability distortion do not relate to being underwater. Finally Model 5 controls for a questionnaire-based measure of the ability to suppress impulsive answers, the Cognitive Reflection Task (CRT), and for self-reported employment security to control for optimism in future income. None of these controls are related to being underwater. The CRT result is particularly important, since CRT is associated with discounting in other studies (Frederick 2005).

Together, these analyses suggest that: 1) both measures of time preference predict underwater status, with more present bias and more exponential time discounting associated with being underwater; 2) this result is likely not driven by the other variables related to the real estate and constraints that may be affected by or affect intertemporal discounting; and 3) the finding is robust after controlling for preferences, including risk aversion, non-linearity in probabilities, and loss aversion, and for differences in abilities, optimism and knowledge.

Walking Away and Time Preferences

The second part of the simultaneous estimation explores the factors that explain underwater homeowners' willingness to walk away from paying their mortgage. Respondents reported the price they believed that their home could be sold for in the current housing conditions.[14] Subjects reported whether they would continue to pay their mortgage given that their home value declined from this value. In this context, willingness to stay is the size of the further decrease in the resale price of the home, a negative amount, at which the homeowner

[14] The subjective home valuations correlated 0.47 with Zillow's zip-code level median home prices, and the measures were not significantly different (difference = $2,382, two-tailed t(166)=0.1366, p=0.89). This suggests the subjective measures are relatively accurate and unbiased.

would continue to pay the mortgage. Hence, when this measure has a slightly negative value, a homeowner is quite willing to walk away. A more negative value corresponds with a greater willingness to stay. Thus this measure increases with willingness to walk away.

Recall that Hypothesis I-3 suggested that more present-biased individuals would be less likely to walk away because the immediate costs of walking away loom large, while individuals who exponentially discount the future more would be more likely to walk away because the residual value of the home is not as important as avoiding the intervening mortgage payments. The model suggests that there exists a range of mortgage payments where both occur, specifically, when the monthly mortgage exceeds the price of an equivalent rental by an amount between a fraction of the short-term moving costs and the full short-term moving cost. Table I-4 summarizes five versions of the simultaneous estimation that demonstrate that present bias and exponential discounting have opposite relationships with walking way intentions. These are again robust to the determinants of risk aversion and relevant demographic, economic, and market-level controls.

All models estimate separate coefficients for positive and negative equity, since negative equity might have a greater impact on walking away. Model 1 reports these coefficients as well as coefficients for present bias and exponential discounting. In this specification, present bias and heavy exponential discounting of future periods have opposite effects on willingness to walk away in response to. Present bias is associated with greater willingness to stay in a home that is further underwater (p=0.026), while the discount fraction is associated with greater willingness to walk away (p=0.023). This predicted relationship in the opposite direction occurs despite the positive (.54) correlation between the two components of time preference and reflects the advantages of staying in the immediate term (e.g. social stigma, moving costs and realization of

Table I-4. Reservation Price for Walking Away

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Present Bias (1-β)	-180,204* (81,194)	-185,343* (75,254)	-162,615* (76,798)	-150,569* (74,590)	-143,239† (76,563)
Exponential Discounting (1-δ)	86,346* (38,038)	85,272* (36,725)	100,714** (36,323)	104,328** (36,136)	96,011** (36,435)
Degree of Positive Equity	-28,724* (13,586)	-13,871 (13,014)	-17,820 (13,093)	-12,330 (13,165)	-18,032 (13,244)
Degree of Negative Equity	21,012 (13,573)	13,822 (12,692)	17,185 (13,101)	20,877† (227,821)	18,330 (13,158)
Proportion Local Homes in Foreclosure		-54,861* (26,076)	-50,173† (26,513)	-52,004* (26,042)	-49,235† (26,313)
Proportion Local Homes in Short Sale		651,776** (228,100)	595,851** (234,613)	550,977* (227,821)	647,538** (233,512)
Proportion Income Servicing Mortgage		-41,399 (59,415)	-62,556 (59415)	-49,073 (57,672)	-69,360 (59,153)
Social Connection to Strategic Defaulters			9,269 (35,715)		
Morality of Strategic Default			-12,730 (23,133)		
Loss Aversion (λ)				16,016† (9,787)	
Diminishing Sens. (σ)				-21.277 (38,627)	
Prob. Distortion (α)				-37,674 (38,627)	
Employment Security					-13,841* (6,954)
CRT Scale					1,281 (7,446)
Expectations about Local Housing Market Changes over 3 Years					-16,118 (69,788)
Confidence in Assessment about Local Housing Market					-11,392 (7,187)
Constant	-143,932*** (17,219)	Purchase Year Fixed Effects	-146,575*** (16,394)	-151,480*** (16,110)	-136,163*** (18,053)
R-sq	0.0957	0.2203	0.1373	0.1643	0.1599
N	226	215	215	206	215

Each column contains 3SLS regression coefficients simultaneously estimated with underwater model, with standard errors in parentheses. *** p<0.001; ** p<0.01; * p<0.05; † p<0.10.

the unfortunate financial position) and advantages to defaulting in the relatively near future (e.g. lower rent). While sizable, this correlation allows the estimation of separate effects for the two components of time preference. As might be expected, the slight tendency for present bias and exponential time discounting to have opposite effects on walking away is increased when the effect is jointly estimated, as in the first regression.

Model 2 controls for possible market-level differences in housing prices and banking policies, using the proportion of the zip code's housing that are currently in short sale, and the fraction in foreclosure. In addition, Model 2 controls for financial constraints by including the proportion of the homeowner's income servicing the mortgage. Both zip code-level variables are related to intention to walk away. Notably, the regression coefficients on these variables suggest that homeowners are more likely to continue paying in zip codes with more foreclosures, and more likely to walk away in zip codes with more short sales (which generally comprise a smaller fraction of homes). Finally, Model 2 also includes mortgage year controls, suggesting that the intention to walk away is not driven by when the home and mortgage were selected. However, the effects of present bias and exponential time discounting remain significant and largely unchanged.

Model 3 adds a measure of the perceived morality of walking away and a measure of the social distance between the homeowner and someone who has strategically defaulted to capture social contagion (White 2010; Guiso et al. 2010). Neither variable is significantly related to intention to walk away. Model 4 included, instead, the individual-level Prospect-theory parameters. This revealed a marginal and unexpected result that more loss-averse people are marginally more likely to walk away, but the effects of present bias and exponential time discounting on walk-away intentions are largely unchanged.

Finally, Model 5 assesses an alternate explanation that overconfidence in the local housing market discourages walking away future income similarly to how overconfidence in future income may encourage excessive borrowing. Browning and Tobacman (2007) note that choices motivated by time preferences can at times be indistinguishable from optimism about future income and income smoothing by time-consistent homeowners. This account would predict that employment security, and expectations about and confidence in the local housing market, which are negatively related to walking away, would fully account for the effect of time preferences on walking away. Controlling for these factors[15], along with the unrelated Cognitive Reflection Task, both present bias and discounting remain significant predictors of walking away.

In sum, the results suggest that time preferences, in addition to being linked to underwater status, are linked with willingness to walk away from one's mortgage. Unlike with underwater status, present bias and exponential discounting have opposing relationships with walking away, despite a high positive correlation between present bias and exponential time discounting. These results are not explained by the local housing environment, liquidity constraints, components of risk aversion, cognitive reasoning ability, debt literacy, nor other demographic controls.

Robustness Checks and Alternate Explanations

Validation of Underwater Status

One concern is that many of the measures involve self-reports. While it might be preferable to employ archival data for some measures, they are not always preferable, nor are the

[15] Specifically, the survey asks "What do you think will happen to home values in your area over the next 3 years?" It also asked about confidence in this assessment and an employment security question with a 5-point scale.

self-reports necessarily flawed. First, it could be argued that it is the perception of financial states rather than the states themselves that might drive decisions. Second, the measures of underwater status seem both reliable and valid. During the prequalification survey and again during the main survey, subjects were asked to assess whether they owed more in mortgage debt than the current market value of their home. Sixty percent of respondents gave exactly the same rating on a 5-point scale, and the two ratings had a 0.76 correlation (Cronbach's α = 0.865). These ratings were averaged for the measure.

Alternate Specifications of Present Bias and Underwater Status

As present bias (1-β) is skewed (see histograms of time preferences in Figure I-A1 of Appendix I-B), additional analysis explores the robustness of the findings to three alternative specifications of present bias. Each regression described in Table I-3 is replicated under each of the following specifications:

1. Median Split: β=0.94
2. 75%–25% Split: β=0.86
3. Logit Transformation: β/(1-β)

These analyses produce estimates for present bias that are in the same direction and largely possess similar levels of significance. The only exception, given the loss of information, is the median split, which shows somewhat less significant results.

The regressions in Table I-4 were replicated, restricting the analysis to underwater homeowners. Despite the restricted sample size (110), each regression replicates the opposing relationships of present bias, exponential time preferences and walking away.

Finally the analysis investigated one alternative explanation of the link between intertemporal preferences and underwater mortgages. Perhaps banks approved loans less prudently in the years immediately preceding the peak in housing prices and made loans to people with different time preferences, so that the results suggest differences in bank policy and not a difference in mortgage choice resulting from present bias and exponential discounting. However, the data do not support this explanation. Regressing years since purchase on intertemporal preference parameters, there is no relationship. To control for any year effects, which might differentially impacting households who mortgaged under different policy regimes, Model 2 of Tables I-3 and I-4 include and exclude yearly fixed effects. While this does increase the model fit significantly, including or excluding the year effects does not substantially change the relationship between time preference and having an underwater mortgage, or with willingness to walk away. This suggests that while there is year-to-year variation in the relationship between being year, mortgage balances and intent to strategic default, these effects are independent of time preferences.

Time Preferences, Liquidity and Mortgage Choice

Finally, analysis further explores the relationship between liquidity constraints, intertemporal preferences and mortgage choices. There are two alternate explanations involving liquidity constraints that compete with the hypothesis that intertemporal preferences directly influence mortgage choices and defaulting behaviors. One possibility is that the measurements of intertemporal preferences expressed by participants are conflated with their preexisting liquidity constraints. Another possibility is that intertemporal preferences could influence choices that affect liquidity, and then facing these constraints, intertemporal preferences do not

further influence mortgage choices. Both of these competing hypotheses are tested through a final series of simultaneous regressions that explore the relationship between intertemporal preferences, liquidity and walking away.

In particular, the analysis assess whether liquidity confounds or mediates the relationship between intertemporal preferences and walking away by adding fraction of income servicing mortgage (inverse liquidity) as an additional endogenous factor to Models 2-5. In each case, in addition to estimating the relationship between intertemporal preferences and underwater homeownership (equation I-3) as well as with walking away (equation I-4), a modified model also simultaneously estimated the relationship between intertemporal preferences and income servicing mortgage (inverse liquidity), equation I-5:

(I-5) $$mort\_pmt\_to\_income_i = \beta_0 + \beta_{l1} * beta_i + \beta_{l2} * delta_i + \varepsilon_{li}$$

The model also included appropriate covariates predicting income servicing mortgage in each model. In the modified models (Models 2a-5a), underwater mortgages and walking away were as specified in Models 2-5, and income servicing mortgage was an endogeneously determined function of present bias and exponential discounting, along with (Model 2a) purchase year fixed effects, (Model 3a) debt literacy, (Model 4a) Prospect theory parameters, and (Model 5a) employment security, and cognitive reasoning.

In each model, the data suggests that liquidity constraints do not account for the relationship between intertemporal preferences and walking away. After accounting for endogenously determined income servicing mortgage (inverse liquidity) the relationship between present bias, exponential discounting underwater status and walking away are unchanged, in significance and magnitude, from relationships when liquidity is assumed to be exogeneous. The fraction of income servicing mortgage is not significant in predicting walking away, though the

direction of its coefficient indicates that increasing liquidity corresponds with increased willingness to default. Income servicing mortgage, in general, increases with present bias and decreases with exponential discounting (all *p*s < 0.10), except in model 3a, which accounts for debt literacy. In other words, liquidity decreases with present bias and increases with exponential discounting. Since willingness to walk away increases with liquidity, the relationship between time preferences and liquidity is directionally consistent with the relationship between time preferences and walking away. Yet even while intertemporal preferences consistently predicting liquidity and walking away, the relationship between intertemporal preferences and walking away is unchanged after accounting for the effect of liquidity.

Discussion

Summary

Mortgage choice and abandonment of a mortgage are both decisions with important consequences for the consumer, lenders, and the state of the economy more generally. Mortgage decisions are also prototypical of many consumer financial choices that that involve a stream of expenditures and consumption occurring across time. This essay focuses on using heterogeneity in time preferences, particularly a present bias, to explain a sequence of decisions concerning mortgages, the selection of a mortgage that may lead to having negative equity, and the decision to abandon a mortgage.

In mortgage choice consumers with stronger present bias are more likely to have borrowed a larger portion of the cost of their home, are more likely to have an adjustable-interest-rate mortgage, and are more likely to have a second mortgage on the home. In addition,

consumers who weight immediate outcomes more heavily or are more present-biased are more likely to be "underwater" with their mortgages. Similarly, those who discount the future more are also more likely to be underwater. Furthermore, the findings do not appear to be driven by the "reverse" effect of underwater status on intertemporal discounting, nor by changes in the stringency of mortgage standards. Finally, the importance of modeling present bias and discount rate for future incomes separately is illustrated by the analysis of walking away from a mortgage. Here present bias and discount rates work, as predicted, in opposite directions. Because the costs of abandoning a mortgage are mostly in the near term, present-biased households are more likely to continue paying a mortgage, even when there is negative equity. In contrast, more discounting of the future, beyond the present (i.e., exponential discounting), was associated with a greater willingness to walk away.

The findings are robust to the inclusion of several controls for preferences including consumer differences in probability weighting, sensitivity to value changes, and loss aversion. In addition, the findings are robust to other individual differences in debt literacy, cognitive reasoning, liquidity constraints, and demographic factors.

Caveats and Future Research

Using behavioral models of time preference is a growing area of research in consumer finance. Yet the initial efforts to understand mortgage decisions are just a beginning. The analysis makes significant use of non-monetary costs such as moving and search costs, and emotional attachment to the neighborhood. It does not, however, explicitly measure these. Similarly, the method discussed here measures preferences for money over time and risk but does not measure preferences over other non-monetary costs. Finally, this essay faces a problem

that is common to most research using the concept of present bias: When is exactly "Now"? In the model, obviously moving into or out of a home does not happen immediately. More complete accounts of time preference should address these questions.

Another concern is reverse causality: Diminished resources may change respondents' time preferences. While the analysis controls for financial circumstances in some of the estimation procedures, and while the ability to control against immediate temptations seems to have a stable component over periods of at least a decade (Eigsti et al. 2006), future research should still examine the relationship between trait-like time preferences and short term changes in circumstances. In the current application, however, it seems unlikely that such an explanation would easily explain why present bias both increases the tendency to be underwater and the opposite effect of decreasing tendency to the walk away. Similarly, this explanation cannot easily explain the opposite relationships of present bias and exponential discounting with willingness to walk away. This account is also not supported in the supplementary analysis with endogenous liquidity. Broadly, one might be concerned that a third factor drives mortgage choices and incidentally correlates with both present bias and exponential discounting. While this possibility is not completely ruled out, such an account must account for these distinctive reversals.

Note also that traditional economic models assume exponential discounting and integration over all future time periods. In contrast, the approach assumes that consumers may treat periods separately. This is consistent with the notion made popular by the term "mental accounting" (Thaler and Johnson 1990, Thaler 1999), suggesting that not all expenditures are considered together. It is also consistent with the idea that consumers bracket transactions

narrowly (Read, Loewenstein and Rabin 1999). However, more research is needed to understand the representation used by consumers when faced with these choices.

Similarly, the present analysis assumes that homeowners are unsophisticated and do not anticipate their future impatience as discussed by O'Donoghue and Rabin (2001) and others. In other words, the analysis supposes that homeowners are, in this context, naive in their time preferences. While the results are consistent with models of consumers who tend to repay more slowly than they expect, such as in Heidhuis and Kosegi (2010), future work might consider the mortgage choices given varying levels of homeowner sophistication.

Finally, the present findings might appear to endorse the view that time preferences have an almost trait-like status, potentially being a stable individual difference that can be used to predict a wide range of complex financial behaviors, such as work linking experimentally elicited time preferences with real-world credit (Meier and Sprenger 2011) and savings (Ashraf, Karlan and Yin 2006, Tanaka; Camerer and Nguyen 2010). This view is further supported by work in decision neuroscience suggesting that intertemporal choices are related to systematic differences in activation of specific regions, notably the ventral striatum (Kable and Glimcher 2007). There is in fact some controversy about whether present bias and discounting over other periods of time involve separate neural systems (McClure et al. 2007; McClure et al. 2004). In support of a multiple-systems account there is evidence that the temporary impairment of the left dorsolateral prefrontal cortex can markedly increase present bias (Figner et al. 2010).

However, despite convincing evidence that intertemporal choice involves neural substrates, present bias and exponential time discounting – parameterized here as $1-\beta$ and $1-\delta$, might also be seen as convenient summaries of more complex cognitive processes because they reflect constructed as well as revealed values. The constructive component is consistent with the

observation that discount rates differ across quantities (Chapman 1996), and that discount rates differ markedly across response modes such as decisions to accelerate or delay consumption (Loewenstein 1988; Weber et al. 2007), or have other context dependent components.

Such a constructive process view suggests possible interventions, particularly combined with the observation that present bias has different roles in mortgage choice and in walking away. In particular, individuals seem to be making decisions that, when viewed jointly, may be problematic. In the first case, overweighting short-term benefits leads them to make mortgage choices that put them at great risk of being underwater and perhaps foreclosure. In the second, they are unlikely to walk away from that mortgage, despite the economic incentives to do so. Both decisions might benefit from the suggestion that decision-makers "frame the future first," by framing intertemporal choices as decisions in an accelerate frame (Weber et al. 2007). This intervention might help this at-risk group to avoid bad mortgages in the first place, and to walk away if warranted.

One consulting firm, the Loan Value Group, has recently marketed a product to banks to convince homeowners not to walk away (Loan Value Group 2010). Their enticement? Money would be given to the homeowner when the mortgage is paid off (RHReward.com 2010). If the analysis is correct that underwater homeowners have both greater present bias and a tendency to discount the future, this intervention is misguided, since they are the people *least* likely to be persuaded by distant payoffs. A more effective strategy, the present research suggests, is a small immediate payoff when each payment is made.

Additionally, the analysis in Essay I suggests that there are strong practical applications of the time preference elicitation procedure developed by Toubia et al. (2012). For example, the tool can be applied in marketing contexts to segment customers and target customers based on

time preferences. Given this new source of information, marketers and policymakers could design financial products and market interventions with intertemporal incentive structures based on a better understanding of time preferences provided by the elicitation method.

To conclude, the analysis of mortgage choice and abandonment suggests principles that can be applied to many consumer decisions that, in economics, would be the province of life-cycle models. The results suggest that ideas that are central to marketing, segmentation and individual differences particularly when applied to the behavioral economic concepts of present bias and personal discount rates would help one understand a broad range of behaviors in consumer financial decisions. These include balancing savings and retirement across the lifetime, the choice to rent or to own, and the decision to insure against longevity risk through annuities.

3

Essay II:

Periodic Pricing Revisited:

Beyond Pennies-a-Day

Summary

Previous research has shown that periodic pricing (i.e., reframing a single payment as a series of payments over time) can increase a consumer's willingness to purchase by making the cost of purchase seem trivial. This essay presents evidence that triviality is neither a necessary nor sufficient condition for periodic pricing to increase willingness to purchase, and it expands the domain of situations where periodic pricing increases purchase. This essay proposes that periodic pricing amplifies consumers' perceptions of a contract's benefits and presents evidence that periodic pricing can be effective even in cases where each payment is not trivial. Evidence from five studies suggests that scope-insensitivity plays an important role in this effect.

Introduction

Marketers have considerable flexibility with how to present prices in ongoing consumer relationships involving contracts. They can present the cost of a subscription, for example, as a single, aggregate price (e.g., $250 a year), or reframe it as a series of periodic payments over time (e.g., 69¢ per day). In many cases, consumers evaluate the offer more positively if it is framed in terms of a number of smaller, periodic payments. This tendency has been called the "pennies-a-day effect" in previous research (Gourville 1998, 1999, 2003).

The current essay supplements and extends this model by investigating how such periodic pricing influences how consumers represent the intangible rewards associated with payment—a topic that is not well-understood. For example, when a nonprofit reframes a single yearly donation as a series of daily payments, it is not well understood how this reframing impacts the satisfaction a donor receives from, say, providing resources to feed hungry children. On a larger scale, car retailers may similarly alter how prospective buyers think about the leasing experience

when they convert its total price into monthly payments or its daily equivalent. This essay explores when and how periodic pricing (e.g. per-day price framing), encourages consumers to inflate the benefits associated with expenditures. It reports results from five studies suggesting that consumers often respond better to a periodic payment plan than to an aggregate price.

In what follows, this essay proposes that periodic pricing affects how consumers think about the benefits associated with a contract. In particular, it will provide evidence that periodic pricing encourages consumers to focus on a particularly salient subset of the benefits the contract offers, and generalize evaluations of this subset to the full set of benefits provided by the contract. For example, when considering whether to agree to a lease of a sports car priced on a daily basis, a consumer will think about the benefits they will experience on the peak experience days and generalize that experience to more mundane days of the lease. In contrast, if the lease is priced on a yearly basis, the consumer will think about the benefits they will experience throughout the year. Overall evaluations of the contract's benefits are more favorable under periodic pricing when consumers are more likely to respond to the presence or absence of the contract's benefit than its magnitude. That is, propose that periodic pricing is most effective when consumers are scope insensitive to the contract's benefits.

In five studies, this essay proposes and shows that periodic pricing alters how consumers evaluate a contract's benefits, and that this explains when periodic pricing encourages consumers to agree to contracts. It will demonstrate that this novel account of periodic pricing enables per-day pricing to be effective even for non-trivial prices and is not explained by diminished cost perception. It will further show that it is most effective in domains where consumers are most scope-insensitive.

Revisiting Periodic Pricing

Previous research has suggested that reframing a cost as a series of small payments makes offers more attractive because consumers view the cost as trivial, similar to other routine expenses that fail to give consumers pause, like buying a cup of coffee (Gourville 1998, 1999, 2003). This essay supplements and extends this research, finding that periodic pricing encourages people to imagine the per-period (e.g. daily) benefits of their purchases while aggregate pricing encourages them to evaluate the contract's aggregate benefit. For example, a dollar-per-day donation request evokes thoughts about how one would impact a starving child on that day, and then generalizes that impression across all days, while a $365/year request evokes thoughts about a year of helping. This essay finds that, in many cases, periodic pricing can increase how consumers perceive the anticipated benefits of each dollar spent. Importantly, this suggests a process through which periodic pricing can increase purchase intentions for non-trivial costs and carries implications for the conditions when pricing on a periodic basis most encourages purchase.

Both the pennies-a-day model and the new perspective offered here are consistent with the view that consumers do not spontaneously combine gains or losses[16] (e.g., convert a daily price to an annual price; Thaler and Johnson 1990; Linville and Fischer 1991), a pattern that has been called the "concreteness principle." The pennies-a-day model and the present framework are complementary examples of this principle in that both find that consumers tend to interpret the deal as it is framed for them (Slovic 1972; Read et al. 1999). Just as the pennies-a-day literature finds that costs are neglected when below some threshold (e.g. $5 in Gourville 2003), it

[16] While they do at times combine losses with gains when gains can cancel losses, consumers generally do not combine gains with gains or losses with losses, and instead evaluate, for example, a series of payments in the frame presented.

is proposed that when marketers bracket costs narrowly (such as in per-day pricing) or broadly (such as in annual, aggregate pricing), consumers tend to construe the benefits using the same frame. The change in how consumers bracket benefits affects how they will evaluate the overall contract.

Narrowly bracketed costs can increase the attractiveness of an offer because consumers evaluate the benefits associated with the payment frame and generalize that evaluation across the rest of the contract. In contrast, when costs are broadly bracketed, consumers evaluate the aggregate benefits as a whole. Since consumers do not value benefits linearly over scale, these frames can produce wildly divergent assessments of the contract's benefits. In particular, periodic pricing most increases assessments of a contract's benefits when the sum of the parts is greater than the whole. Such is the case when consumers respond to the presence of a stimulus but are appreciably less sensitive to changes in its magnitude, which is known as "scope-insensitive" (Hsee et al. 2005).

Consumers often evaluate a bundle of goods based on an affective response to a representative unit of that good rather than the quantity in the bundle (Kahneman, Ritov and Schkade 1999). For example, one study presented three groups of respondents with an opportunity to cover deadly oil pools with nets that would save either 2,000, 20,000 or 200,000 birds and found that these three groups expressed nearly equal willingness to pay to save birds despite the hundredfold increase in impact (Desvousges et al. 1992). In other examples, consumers are willing to pay only a little more to clean all the polluted lakes in Ontario than for a much smaller regional cleanup (Kahneman and Knetsch 1992), and only 28% more to protect 57 wilderness areas than a single area (McFadden and Leonard 1993). Perhaps most alarmingly, well-intentioned consumers are not aren't willing to pay more if they are able to save ten times

as many lives (Baron and Greene 1996). Especially important, for present purposes, is that scope-insensitive preferences tend to reflect a high valuation of the first few units of a good while further units provide little or no perceived marginal benefit.

Not all consumers' evaluations are scope-insensitive to the same degree. For example, consumers are more scope-insensitive to many product categories than they are for money (Frederick and Fischhoff 1998). It is easier to evaluate the desirability of some attributes than others, which suggests that product categories with less evaluable attributes would be more scope-insensitive than those with more evaluable attributes (Hsee, Loewenstein, Blount and Bazerman 1999). Hsee and Rottenstreich (2004) propose that value is constructed through the combination of affect-based and calculation-based processes. They propose that affect-based processes produce scope-insensitive valuations. These affective processes can be influenced by changing feelings associated with a stimulus directly, such as by varying one's affective involvement with the target good, or indirectly by shifting attention to affective processes. Finally, research involving within-subjects evaluations of scale have found that scale influences judgments when scale information is salient and interpretable (Kahneman, Ritov and Schkade, 1999). This essay proposes that periodic pricing furnishes a context ("a narrow bracket") that helps consumers interpret the magnitude of a contract's benefits.

The present research proposes that narrowly-bracketed costs evoke narrowly-construed benefits, and that these narrowly-construed benefits (e.g., the warm glow from the first day of donating to a charity or the first day of a lease for a new luxury sedan) seem more attractive relative to the narrowly-construed cost than broadly-construed benefits do relative to their larger, aggregate costs. In other words, while aggregate pricing encourages consumers to imagine that the contract bestows less value beyond that of the first unit, periodic pricing encourages

consumers to evaluate the benefits associated with a period of the payment frame (e.g., a day) and then generalize that evaluation across all periods of the payment frame (e.g., across the 365-day length of the contract or lease). So, the idea of narrowly-framed benefits, combined with the idea of scope-insensitivity, gives rise to the predictions about the conditions under which periodic pricing will cause consumers to find offers more attractive.

This essay argues that periodic pricing serves to magnify the attractiveness of offers involving emotional and/or symbolic product categories. For example, an activist presented with an opportunity to donate to his or her cause on a daily basis will imagine the joy of helping *a little every day*, which feels better than 1/365 of the equivalent yearly donation. Consequently he or she will donate a dollar per day to the cause when he or she would not donate $365 per year to the cause. Convergent evidence from five studies suggest that periodic prices encourage consumers to narrowly-bracket a contract's anticipated benefits, and that this can cause consumers to be more likely to agree to a contract involving more payments to one requiring fewer payments.

More specifically, the present research proposes and finds evidence in support of four distinct but related hypotheses:

Hypothesis II-1: *Periodic pricing can magnify how consumers perceive a contract's benefits, which can lead to purchase.*

Hypothesis II-2: *Periodic pricing can encourage purchase when costs are not perceived to be trivial.*

Hypothesis I-3: *Periodic pricing is most effective when consumers value a contract's benefits in a scope-insensitive manner*. This happens, for example, when the product category being considered is relatively emotional, prompting valuation by affect rather than valuation by calculation.

Hypothesis II-4: *Consumers are more likely to agree to contracts under periodic pricing than aggregate pricing because periodic pricing improves how consumers perceive the contract's least valued units rather than amplifying how they perceive its most valued units.*

The final two hypotheses provide insight into when and why periodic pricing magnifies how consumers perceive a contract's benefits, and thus qualify Hypotheses II-1 and II-2. These hypotheses are consistent with a view that periodic pricing frames benefits narrowly, which helps counteract declining marginal sensitivity by generalizing the value conferred from a single period of time across all time periods. In other words, narrowly bracketing costs similarly brackets the benefits, and the sum of the parts is disproportionately greater than the whole for benefits than for costs.

In what follows, five studies ask participants to make a hypothetical purchase decision where the cost is framed either on a periodic or single-payment basis. Yet the surveys clearly state (and verify that participants understood) that actual payments will be automatically withdrawn from their paycheck with an intermediate frequency held constant across conditions. This allows one to differentiate framing effects from time preferences, as in Gourville 1998. Study 1 closely resembles the original pennies-a-day paradigm. It finds, consistent with Hypothesis II-1, that much of the benefit of periodic pricing is attributed to changes in imagined

personal benefits of donating independently from changes in perceptions of the donation cost. Study 2 examines a domain where pennies-a-day would predict that periodic pricing would fail, namely leasing luxury sports cars, and provides a direct test of Hypothesis II-2. Although participants indicate that payments are not considered trivial, their responses suggest that periodic pricing again increases purchase intentions, and that this is attributed to changes in perceived benefits, which also provides further support of Hypothesis II-1. The data suggests that the mediating role of greater anticipated benefits in Study 1 and 2 is not explained by decreased price perceptions.

Study 3, manipulates scope-insensitivity to impact the strength of periodic pricing to test Hypothesis II-3. The results suggest that periodic pricing is more effective when consumers care more about whether they obtain at least one unit of a good than they do about obtaining additional units. Study 4 provides additional process-level evidence in support of the new account of periodic pricing as given by Hypothesis II-4. Namely, narrow bracketing increases how consumers perceive a contract's benefits by generalizing the highly-anticipated periods to other periods rather than magnifying perceptions of the highly-anticipated period. Finally, Study 5 replicates Study 2 while assessing the roles of cognitive capacity limitations, psychological distance differences and financial literacy as potential alternative explanations, and provides further evidence for Hypothesis II-4. The essay concludes with a broader discussion of the implications of the expanded theory of periodic pricing.

General Experimental Design

This section outlines the general experimental design used in each of the five studies. In each study, participants were presented with a hypothetical contract to make a series of

payments. Depending on the study, these payments were described as going to a charitable cause or towards a luxury purchase. Depending on the condition, the payment was framed narrowly (as a per-day cost) or broadly (as a per-year cost), and participants rated how likely they were to agree to the contract on a 0-10 slider scale (see Appendix II-A).

Importantly, across all conditions, payment was described as being automatically deducted from participants' monthly paycheck. This ensured that 1) contract framing could be distinguished from intertemporal preferences, and 2) that there was not a concern about greater transaction costs (in time or money) associated with more frequent payments. Additionally, the payment was generally weighted slightly in favor of the broad payment frame (i.e. the per-day cost more over the year) which further helps ensure that any preferences for more payments are financially meaningful.

One other design feature common to Studies 1-4 (except 3b) is that participants were asked to reflect on the benefits associated with the contract prior to assessing it. This step appeared in several studies in order to explore how costs influence perceptions of benefits. Additionally, this feature reflects the natural consideration process of consumers before many actual purchases. Notably, when this step was altered in Study 3b and eliminated from Study 5, the results suggest that reflecting on benefits was not necessary for periodic pricing to increase a contract's perceived benefits.

Study 1. Pleasure of Daily Donations

Overview

Study 1 explores consumers' perception of costs and benefits in charitable giving and how these perceptions affect their willingness to give. Participants read about a hypothetical

opportunity to donate a daily amount or an equivalent yearly amount to a charity and tested how the daily vs. annual frame affected their perceptions of the offer's costs and benefits. If participants are more likely to donate when the costs are framed as daily donations, it could be because of one (or both) of two possibilities. One possibility is that the daily frame may lead participants to anticipate more daily pleasure from giving, which would be consistent with the "reframed / amplified benefits" account and Hypothesis II-1. Alternately (or additionally), participants may perceive the cost to be more trivial (as predicted by the pennies-a-day model). If anticipated daily pleasure accounts for the effect of daily frame on donation assessments, there is also a third explanation that is tested in this study: participants may anticipate more daily pleasure because the costs are more trivial, rather than because the frame changes perceived benefits directly. The purpose of Study 1 was to test the relative explanatory power of perceived costs and benefits in whether a daily payment frame increases donation likelihood.

Method

150 complete surveys were provided through an online panel of unique participants drawn from the Amazon Mechanical Turk population who had at least a 98% approval rating and were located in the United States. Participants were asked to consider paying a donation framed either on a per-day basis [periodic price frame] or yearly basis [aggregate price frame]. As in later studies, participants were told that the actual donation would be automatically deducted from their monthly paychecks and the contract term was fixed to control for time preferences. They considered their choice in a hypothetical design scenario closely modeled after Gourville (1998):

> Imagine that you are earning $50,000[17]. Your company is sponsoring a donation drive to help the underprivileged in the United States. Your participation would be optional and completely anonymous.
> If you choose to make the requested donation, it would be automatically deducted once per month from your paycheck for one year.[18]
>
> Requested Donation:
> $350 per year *(*$1 per day)
>
> Next, please pause for a moment to imagine what benefits you would receive if you agreed to donate the amount requested. Please briefly describe how you would feel. (Approximately 10-20 words are sufficient.)[19]

Participants then evaluated the offer, answering the five questions below on a 0-10 scale:

1. What is the likelihood you would agree to donate the amount requested?
2. How attractive is the donation opportunity?
3. How favorable is the offer?
4. Would you feel better if you made the donation or if you didn't make the donation?
5. Overall, how valuable is the contribution, compared with its cost?

Next, the participants answered questions that would help identify differences in perceived costs and benefits depending on the price frame:

1. How trivial is the amount you were asked to pay?
2. How much daily pleasure would you get from donating the requested amount to the cause?

These questions served as the basis for perceived costliness and benefits associated with the donation opportunity. The analysis evaluates how the two price frames influenced

[17] Participants reported annual income to be, on average, $52,673 (SD 40,255). This follows Gourville (1998) in asking participants to make this assumption about hypothetical income when considering donation requests.

[18] The emphasis on monthly deductions was included in the description to all participants, to ensure that the differences are due to framing and not temporal discounting. Note also that the yearly price frame is less expensive than the daily price frame. These are features borrowed from Gourville's (1998) design.

[19] Participants were asked to explicitly consider benefits in order to increase the salience of benefits under both the yearly and daily frame. Importantly, this instruction was held constant across conditions and was removed in later studies.

participants' purchase assessments and their perceptions of the contract's costs and benefits. It also evaluates whether differences in participants' perceptions explain their purchase intentions.

Results

As Figure II-1 shows, periodic pricing increases all five purchase assessment measures. Consistent with Gourville (1998), donation likelihood ratings increase (yearly vs. daily frame; M_{yearly} = 5.1, SD = 3.3 vs. M_{daily} = 6.1, SD = 3.4; $F(1,148) = 3.55$, $p = 0.06$). Additionally, periodic pricing increases the perceived attractiveness of the offer (M_{yearly} = 5.8, SD = 2.7 vs. M_{daily} = 6.8, SD = 2.8; $F(1,148) = 4.63$, $p = 0.03$) its favorability (M_{yearly} = 6.4, SD = 2.4 vs. M_{daily} = 7.2, SD = 2.3; $F(1,148) = 4.54$, $p = 0.03$), the comparisons of feelings (M_{yearly} = 5.8, SD = 2.7 vs. M_{daily} = 7.2, SD = 2.4; $F(1,148) = 12.26$, $p < 0.001$) and the perception of the contribution's value compared with its cost (M_{yearly} = 6.4, SD = 2.6 vs. M_{daily} = 7.4, SD = 2.3; $F(1,148) = 5.70$, $p = 0.02$). Responses to these items were standardized and averaged into a purchase assessment scale constructed from average z-scores (Cronbach's $\alpha = 0.89$). That purchase assessment index was higher under the periodic price frame than under the aggregate price frame (M_{yearly} = -0.20, SD = 0.8 vs. M_{daily} = 0.19, SD = 0.8; $F(1,148) = 8.24$, $p < 0.001$). These results suggest that periodic pricing elevated people's evaluations of the offer.

The analysis next compared consumers' perceptions of benefits and costs across the two conditions. The results indicate that perceptions of daily pleasure increased under periodic pricing (M_{yearly} = 4.8, SD = 2.8 vs. M_{daily} = 4.8, SD = 2.8; $F(1,148) = 4.84$, $p = 0.03$) while triviality ratings did not differ significantly (M_{yearly} = 4.2, SD = 2.8 vs. M_{daily} = 4.9, SD = 3.2; $F(1,148) = 2.22$, $p = 0.14$). Daily pleasure and cost triviality are each highly correlated with donation assessments ($r_{pleasure} = 0.62$, $p < 0.0001$; $r_{trivial} = 0.46$, $p < 0.0001$).

Figure II-1a. Donation Intentions, by Price Frame

Daily price frame increased multiple donation intentions measures.

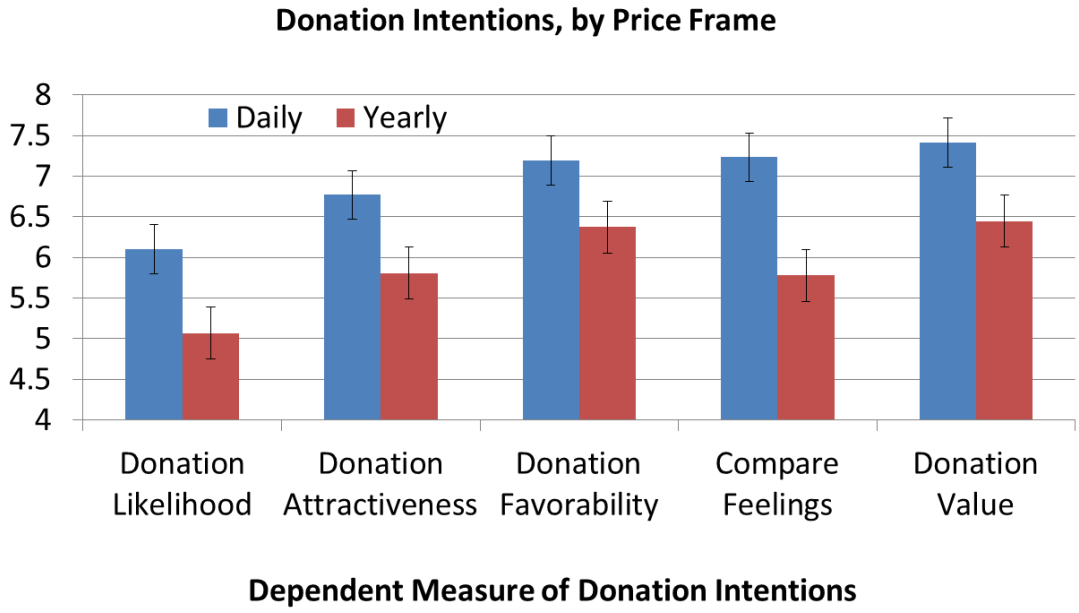
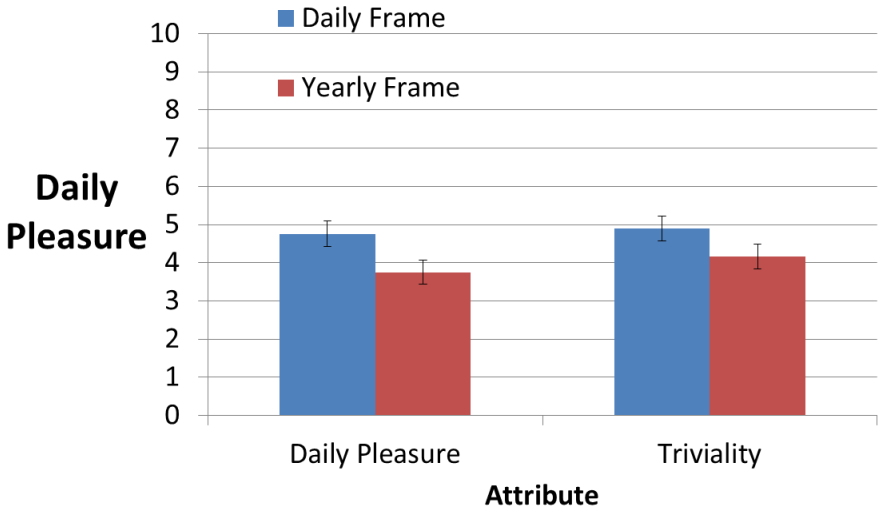


Figure II-1b. Daily Pleasure and Triviality and Payment Frame

Perceived daily pleasure increases under periodic pricing, while views of triviality do not change significantly.



To examine how much each factor of interest—the perception of benefits (anticipated daily pleasure) and of costs (perceived cost triviality)—contribute to the effect of periodic/aggregate pricing on donation assessments, the analysis jointly estimates simultaneous equations with two mediators. The analysis follows the mediation testing procedure developed by Preacher and Hayes (2008) and endorsed by Zhao, Lynch, and Chen (2010). Three equations were simultaneously estimated through seemingly unrelated regression (SUR) to assess the related relationships between 1) benefits as a function of payment frame, 2) costs as a function of payment frame, and 3) donation intentions as a function of benefits, costs and frame. Resamples were bootstrapped 5000 times and this determined a 95% confidence interval. If this confidence interval excludes zero, the data indicates the presence of a significant mediator, with $p<0.05$.

The results indicate that the indirect effect of daily pleasure mediates daily payments and donation intentions (β=0.16, 95% CI = {0.01 , 0.30}, p = 0.03) while cost triviality falls short of statistical significance (β=0.08, 95% CI = {-0.03, 0.18}, p = 0.17)[20]. Most tellingly, 40% of the total effect of daily payments on donation intentions is explained by daily pleasure, double the effect of cost triviality. This result is not predicted by the pennies-a-day framework, and it provides further evidence that periodic pricing changes the perceptions of an offer's benefits in addition to its costs.

One potential concern is that cost triviality may be a noisier measure than perceived benefits. To test this, an additional model was estimated with multiple measures of cost perceptions to increase reliability of the cost perception measure. Ratings for cost triviality, expensiveness and costliness were combined into a single factor using principle-component

[20] To assess the triviality measure's validity, the survey asked for ratings of two other cost-related questions: expensiveness and costliness. These measures correlate with triviality -0.56 and -0.59, respectively. To allow an additional test of the hypotheses, an additional bootstrapped model of simultaneously estimated equations that includes all three cost-related questions along with daily pleasure as mediators, and the results persist (β=0.15, p=0.03).

analysis.[21] In this model, relative to the aggregate frame, in the periodic price frame participants perceived the contract's benefits to be higher (p=0.027), costs to be lower, donation intentions increase with perceived benefits (p<0.001) and donation intentions decrease with perceived costs (p<0.001). The indirect effect of periodic pricing on donation intentions through perceived benefits remains roughly the same size and direction (β=0.16, 95% CI = {0.02 , 0.30}, p = 0.03) and the indirect effect through cost perceptions is larger than the model with a single-measure and is statistically significant (β=0.16, 95% CI = {0.04 , 0.30}, p = 0.02). So while improving the reliability of the perceived cost measure improves the explanatory power of cost perceptions, the perceived benefits results are not an artifact of low reliability in the perceived cost measure. Importantly, this analysis highlights that the present research supplements and extends the pennies-a-day model rather than presenting contradictory evidence.

Finally the analysis tests another alternate hypothesis, namely, that participants may have felt additional pleasure merely because they the cost seemed smaller, rather than due to the alternate bracketing itself. To test this, the simultaneous equation model was modified to make perceived benefits a function of perceived costs. The analysis tested whether perceived benefits continued to mediate daily frame and the donations scale despite this effect, or alternately, whether the indirect effect of perceived benefits is itself mediated by perceived costs. The results suggest that daily pleasure again mediates daily payments and donation intentions (β=0.13, 95% CI = {0, 0.27}, p = 0.05).[22] In contrast, the path price frame -> cost triviality -> perceived benefits -> donation intentions is not significant (β=0.02, 95% CI = {-0.01, 0.06}, p =

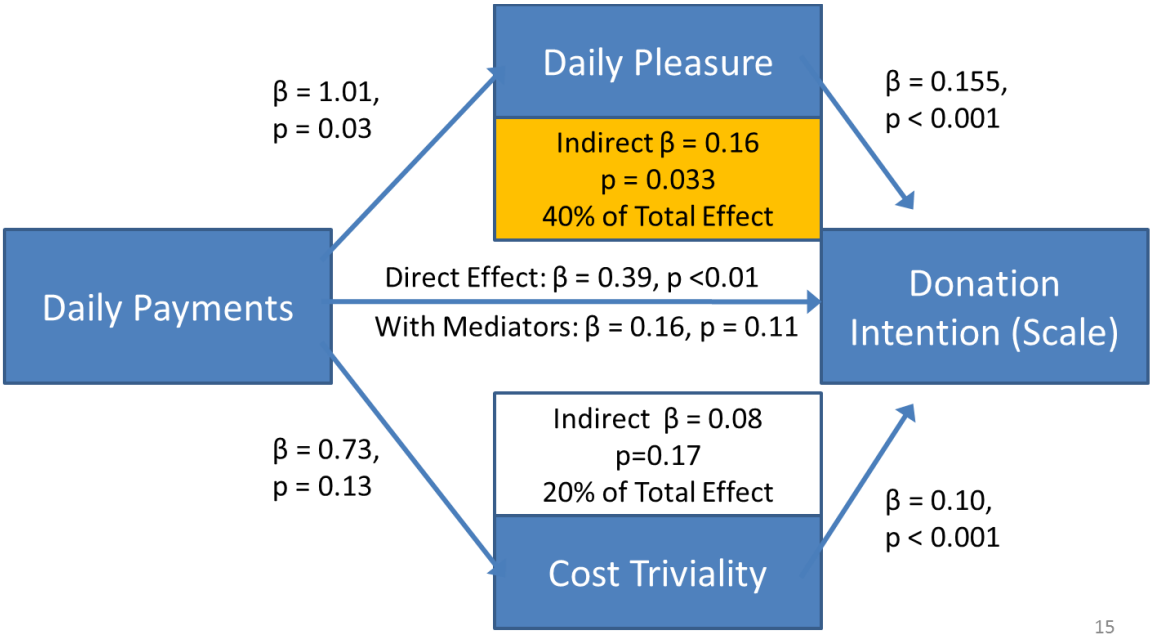
[21] The three measures were well represented by a single factor as the eigenvalue for that factor was 2.3 while all other eigenvalues were well less than 1.

[22] The bias-corrected confidence interval excludes zero, suggesting that the indirect effect is statistically significant with p<0.05.

0.23). This suggests that the mediating effects of benefits are not explained by the whether the costs appear trivial.

Figure II-1c. Mediating Payment Frame and Donation Intentions

Perceived daily pleasure mediates the relationship between daily payments and donation intentions more strongly than cost triviality.



Joint estimation of 2 paths through 3 simultaneous equations (SUR); bootstrapped with 5000 replications. (Method discussed by Preacher & Hayes, 2008)

Discussion

Study 1 provides evidence that periodic pricing increases purchase assessments and that this is substantially driven by how periodic pricing changes the perceived benefits of the offer. People expect the donation to bring them more daily pleasure, and as a result they assess the purchase more positively.

The novel account offered herein predicts this novel result as Hypothesis II-1. One implication of the present framework is that periodic pricing can increase purchase intentions outside the trivial cost domain. This prediction (Hypothesis II-2) is explored in Study 2.

Study 2. Not Just Pennies

Overview

Study 1 found that periodic pricing can increase the attractiveness of an offer by changing the representation of its benefits. If periodic pricing increases purchase assessments by magnifying the offer's benefits, then periodic pricing could, in theory, increase purchase intentions even when costs are not perceived as trivial. This prediction (Hypothesis II-2) stands in contrast to previous research, which found that periodic pricing has a ceiling around $5 per day for university students above which the strategy would backfire (Gourville, 2003). In that study, respondents would rather pay a monthly sum rather than daily payments made towards property taxes ($11.50/day), rent ($25/day), home mortgage ($49/day), and income tax ($58/day). In other words, previous research has found a reversal for large amounts of money.

Yet anecdotal evidence suggests that per-day pricing can work for non-trivial costs since well-known brands have successfully framed goods on an expensive per-day basis. The Acura TL leases for $12 per day. Disney offers 4-day passes for $30 per day, and Carnival offers three-to-seven day cruises for $70/day. Note that these product categories are more hedonically appealing than the rather pragmatic categories tested in the previous study. Unlike the other expensive product categories previously examined, cars and cruises are exciting products prone to high affective valuation: imagining a single day with the product engenders a pleasant, vivid image.

Study 2 tests whether per-day pricing can increase willingness to agree to lease an affect-rich car for a non-trivial amount of money-- $20. Appendix II-B tests whether $20 is still considered non-trivial when it is such a small fraction of the total underlying base cost of a car. That ancillary study changed by 10x the daily price of a car ($2 to $20) and its total cost underlying price ($10k to $100k) and asked participants whether they viewed the cost as trivial or expensive. Comparing effect sizes, the 10x change in daily price accounted for 23% of variance while the 10x change in base price accounted for only 1% of variance. It appears that cost perceptions are determined by the recurring price paid rather than the price relative to a base reference cost.

In Study 2, participants were expected to prefer to pay for a luxury automobile—an affect-rich product—on a daily basis, even when the costs are not considered trivial. If this prediction, Hypothesis II-2, is supported, it would be the first evidence that the effects of periodic pricing on purchase intent are not restricted to small amounts of money. Additionally, it would be further evidence that something other than cost triviality is at play in affecting consumer preference. However, if perceived costliness is the only thing making narrow periodic pricing effective, there should be no effect or a greater willingness to accept the offer under the aggregate (yearly) price frame. The data also allows testing another alternative, that periodic pricing may change perceived benefits because it changed perceived costliness, rather than because it changed how participants bracket the lease's benefits.

Method

Sixty online panelists were asked to imagine leasing their choice of four luxury cars[23]. Panelists viewed a picture of each and were told that the 36-month lease cost $20 per day [periodic price frame] or $7,250 per year [aggregate price frame]. They then read the following scenario:

> **The Scenario**
> Suppose your current employer offered to subsidize your choice among several luxury automobiles.[24]
>
> **Terms**
> A 36-month lease, with unlimited miles. Payments would be automatically deducted from your monthly paycheck.
> Your employer is willing to pay all additional taxes and fees and heavily subsidize the lease payment. They will also provide comprehensive insurance for the car at no additional cost. This means that you can lease the car at a steep discount. If you reject the offer, you will not receive any alternate compensation from your employer.

Following the statement of the lease terms, four cars were listed with their retail prices and images from automotive.com. As in Study 1, the participants reflected on the benefits they would receive from the contract prior to responding to the dependent measures.

Participants rated their likelihood of agreeing to the lease, how fun it would be to lease the car, and the cost triviality of the lease price on 0-10 scales. Finally, participants rated some additional items: how important it is to own a nice car, knowledge about cars, experience with the car (hours driving, whether they drive), gender, age, income, and language fluency. Any of these factors could affect people's preferences for luxury automobiles and thus could act as confounding variables.

---

[23] The luxury cars included 2011 Mercedes-Benz E550 Sedan (Retail Price: $59,600), 2011 Lexus LS 460 (Retail Price: $65,380), 2011 BMW 5-Series 550i Sedan (Retail Price: $59,700), and 2011 Cadillac STS (Retail Price: $52,720) and the sample was drawn from Amazon Mechanical Turk's population in the United States with an approval rating of at least 98%.

[24] The employer subsidy is immaterial as the results show that the mediation by perceived benefits is not explained by cost perceptions. Additionally, other studies were not employer-subsidized.

Participants were predicted to be more likely to agree to the auto lease that quotes a daily price rather than one that quotes a yearly price. It was further expected that ratings of how fun the car is to drive (rather than or in addition to cost triviality) would account for the effect.

Results

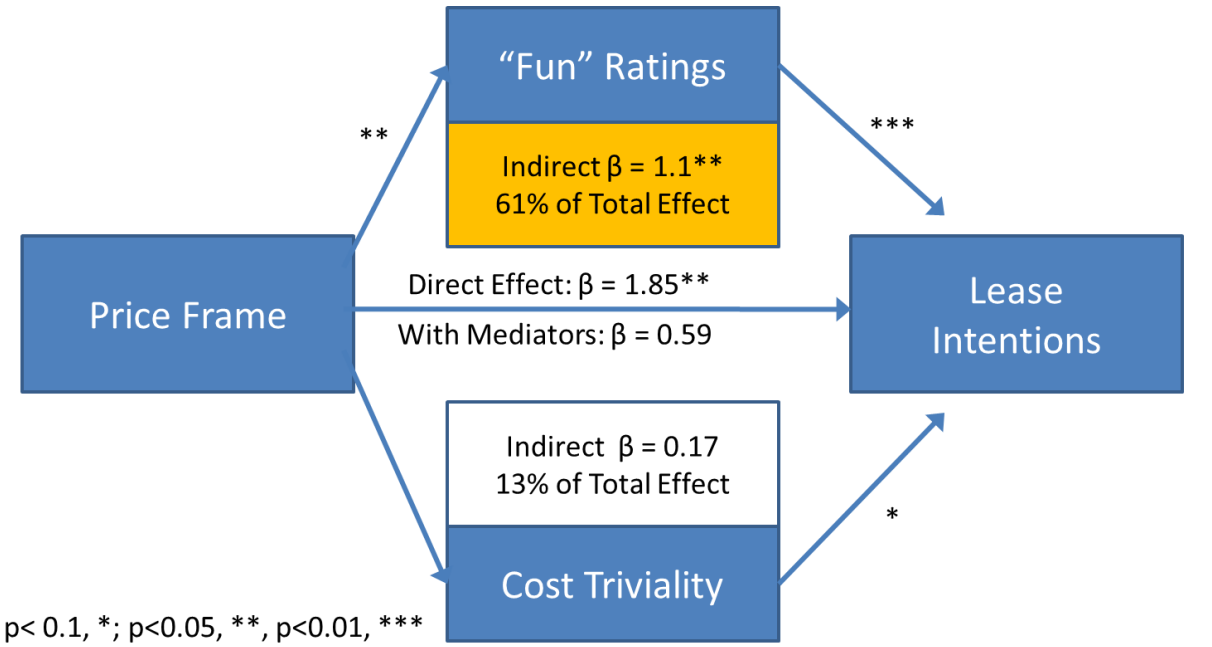
Participants were more likely to agree to the lease in the periodic price frame than the aggregate frame (yearly vs. daily frame; $M_{yearly} = 5.0$, SD = 3.6 vs. $M_{daily} = 6.9$, SD = 2.7; $F(1,58) = 4.89$, $p = 0.03$), an effect which remains significant when controlling for the potentially confounding variables ($F(1,50) = 5.18$, $p = 0.03$). Participants in the periodic price frame were directionally more likely to report that it would be more "fun" to lease the car ($M_{yearly} = 6.6$, SD = 2.9 vs. $M_{daily} = 7.6$, SD = 2.1; $F(1,58) = 2.23$, $p = 0.14$) and that the cost is directionally more trivial ($M_{yearly} = 2.8$, SD = 2.9 vs. $M_{daily} = 4.0$, SD = 2.8; $F(1,58) = 2.26$, $p = 0.14$). Controlling for the potentially confounding variables, participants expected the car lease to be more fun in the periodic price frame than the aggregate price frame ($F(1,50) = 4.59$, $p = 0.04$). However, controlling for these same variables, the differences in the triviality ratings was not statistically significant ($F(1,50) = 1.64$, $p = 0.21$). In each condition, participants reported that the price of the car was below the middle triviality rating value, 5 (yearly: $t(31) = -4.1468$, $p = 0.0001$; 95% CI = {2.2, 3.8}; daily: $t(27) = -1.95$, $p = 0.03$; 95% CI = {2.9, 4.6}).

The analysis next examined how well anticipated fun and cost triviality account for the differences between periodic and aggregate pricing on lease intentions. As in Study 1, simultaneous equations were jointly estimated using seemingly unrelated regression (SUR) with the two mediators and the control variables and bootstrap 5000 times. As shown in Figure 2, anticipated fun significantly mediates price frame and lease intentions (β=1.09, 95% CI = {0.07,

2.05}, p = 0.03) while cost triviality does not (β=0.17, 95% CI = {-0.10, 0.77}, p = 0.46). How fun it would be to drive the car explains over 60% of the relationship between pay frequency and lease likelihood, while triviality accounts for 10%.

Figure II-2. Mediating Payment Frame and Lease Intentions

Willingness to lease the car increases under periodic pricing and is mediated by how fun the car would be to lease.



Finally, a modified model again allows a test of whether the mediating role of perceived benefits was explained through changes in perceived costs rather than directly by the price frame. In the modified version simultaneous equation model, anticipated fun was considered to be a function of cost triviality. The results indicate that anticipated fun still significantly mediates price frame and lease intentions (β=1.02, bias-corrected 95% CI = {0.18, 2.25}, p =

0.04). The path price frame -> cost triviality -> anticipated fun -> lease intentions was not significant (β=0.02, 95% CI = {-0.06, 0.15}, p = 0.72). This suggests that anticipated fun did not increase merely because perceived costs decreased, but rather that the daily frame directly changed how participants thought about the benefits of the lease.

Discussion

Study 2 finds an effect of periodic pricing on willingness to purchase for a decision where costs are clearly not trivial[25]—a result which cannot be explained by the pennies-a-day framework: people were willing to pay for a luxury automobile that is priced on a daily ($20) basis rather than on a yearly ($7,250) basis. This result is consistent with Hypothesis II-2, and provides further evidence that something apart from the trivialization of cost makes periodic pricing effective. Consistent with the results of Study 1 and providing further support for Hypothesis II-1, Study 2 suggests that people perceive greater benefits in the daily cost condition. They think it would be "more fun" to lease the car, and this fully mediates the periodic pricing effect.

The results of Study 2 contrast with the finding that periodic pricing backfires for large payments (Gourville, 1998). This is attributed to the difference in product categories used in the previous versus those used in Study 2. Namely, the product categories used in previous research were dull and functional, whereas the current study presented an offer for a flashy, hedonic product – a new sports car – a prospect that is particularly exciting on the first day but provides less additional value with each subsequent day. In other words, the findings may have resulted

[25] The daily price far exceeds the $5 upper-bound suggested by previous work (Gourville, 2003), and respondents indicate that the price frames are considered equivalently nontrivial. To evaluate a potential concern that $20 may seem to be trivial relative to the price of the car, Appendix II-B describes an ancillary study finding that a lease's daily cost influences triviality perceptions much more compellingly than the daily cost relative to the car's book value.

because participants were presented a highly valued, but scope-insensitive stimulus. The next study provides a more direct test of the relationship between scope-insensitivity and periodic pricing effectiveness.

Study 3. Scope Insensitivity and Daily Donations

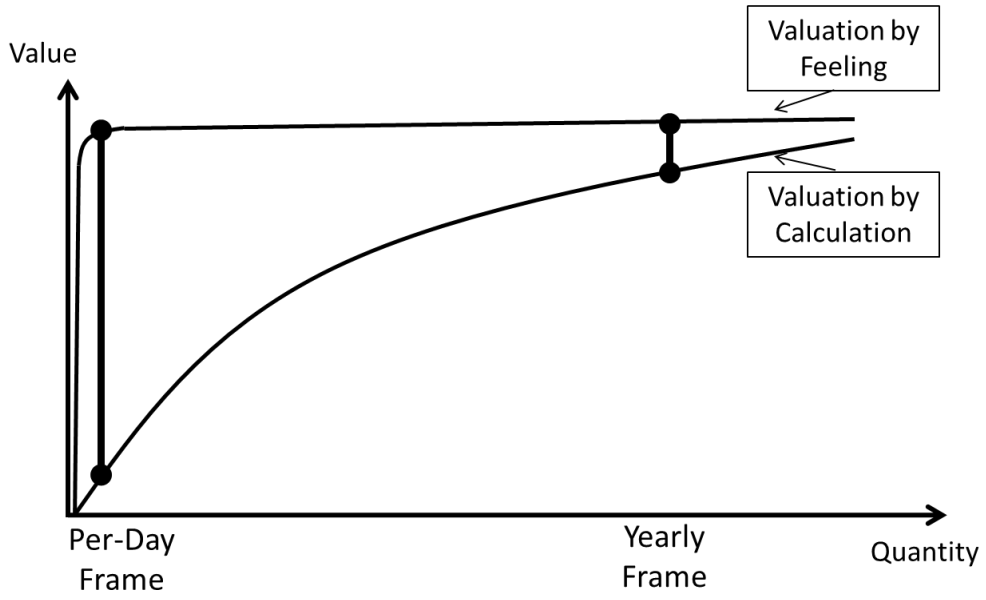
Overview

Study 3 explores the role of scope-insensitive preferences on how consumers represent a contract's benefits differently under periodic pricing and aggregate pricing. It is expected that periodic pricing will be more effective when the contract's initial benefits convey dramatically more value than subsequent units (Hypothesis II-3). In other words, the boost in purchase intent – which this essay argues is produced by the inflation/magnification of an offer's benefits – is most pronounced when consumers are relatively scope-insensitive over the contract's benefits. As Figure II-3a shows, narrow cost bracketing amplifies total perceived benefits by encouraging consumers to adopt narrow benefit bracketing, which increases reliance on the highly valued initial unit.

Study 3 manipulates scope-insensitivity to find further evidence that periodic pricing is most effective when the contract's benefits are scope-insensitive with a large initial onset (the big initial spike). Past research has found that affective involvement increases scope-insensitivity by promoting valuation by feeling over valuation by calculation (Hsee, Rottenstreich and Xiao, 2005). This study manipulates scope-insensitivity using two different methods that encourage participants to evaluate a contract's benefits more through valuation by feeling or valuation by calculation.

Figure II-3a. Valuing Scope Insensitivity

When a contract's benefit schedule is scope-insensitive, periodic pricing increases the benefits associated with each dollar spent.



Consistent with Hypothesis II-3, the general prediction is that, in each experiment, periodic pricing will increase contributions to a charity more when valuation is more scope-insensitive, which is when subjects rely more on valuation by feeling over valuation by calculation. First, Study 3a asks some participants to read a passage that ties positive affect to the contract's benefits, while a control group reads a passage with unrelated positive affect. Second, Study 3b describes an opportunity to donate to a charitable cause either in the presence or absence of an emotionally evocative picture. In each case, it is expected that, consistent with Hypothesis II-3, periodic pricing will increase contributions to a charity more under the more emotional appeal. In contrast, if periodic pricing does not influence how consumers represent the contract's benefits, the results would show no interaction between the manipulations of scope

sensitivity and price frame. This lends further support to the notion that periodic pricing is strongest when the contract's benefits possess a large initial spike.

Study 3a Overview

In this study it is expected that, consistent with Hypothesis II-3, periodic pricing will increase contributions to a charity more after reading a passage that ties positive affect to the contract's benefits compared with after reading the control passage with unrelated positive affect. The two passages were pretested to verify that they induce different degrees of scope-insensitivity by investigating how much participants are willing to work for various donation amounts. Then the study manipulated the passage and donation request frame (daily or yearly) to test whether, consistent with Hypothesis II-3, the passage increased the ability of periodic pricing to increase charitable contributions. In contrast, if periodic pricing does not influence how consumers represent the contract's benefits, the results would show no interaction between price frame and the passage read.

Study 3a Method

This study provided 227 online participants with a hypothetical opportunity to donate to the breast-cancer cause, Susan G. Komen for the Cure®. To manipulate scope-insensitivity, the survey asked participants to read a passage evoking differing levels of affective involvement with the cause. Participants were assigned to a low affective involvement with the cause [scope-sensitive] or high affective involvement with the cause [scope-insensitive] condition, and were quoted a price on a per-day basis [periodic price frame] or a per-year basis [aggregate price frame].

Under the condition with high affective involvement with the cause, participants read:

> Imagine that one of your closest loved ones has been fighting breast cancer for years. How would you feel learning that her life may be saved by a new treatment made possible by Susan G. Komen for the Cure?

Under the condition with low affective involvement with the cause, participants read the following statement, which was verified to generate an equivalent mood[26], but not to provide nearly the affective involvement with the cause:

> Think about how it would feel to receive an unexpected card in the mail today from a loved one—just someone reaching out to let you know they care.

As in Study 1, participants were quoted the asking price ($1 per day or $350 for the year) and asked to pause and write about what benefits they would receive if they agreed to donate.

Study 3a Pretest

First, a pretest tested whether the affective involvement manipulation influenced scope-insensitivity. Though the manipulation is conceptually based on the affective involvement manipulation used by Hsee and Rottenstreich's (2004) Study 4[27], it was important to ensure that the particular affective involvement manipulation similarly manipulated scope sensitivity.

In the pretest, 325 participants were asked how long they would be willing to work for Komen to receive an amount of money. Participants were first either exposed to the high affective involvement or low affective involvement condition, then read a scenario:

> Susan G. Komen for the Cure, the global leader of the breast cancer movement, having invested nearly $1.5 billion since inception in 1982.

[26] Positive and negative affect were measured through short PANAS (Mackinnon et al. 1999) and there were no significant differences (*p*s> 0.20).

[27] In that study, participants in a high affective involvement condition were asked to put themselves in the position of a mugging victim and write about how they would feel.

> As the world's largest grassroots network of breast cancer survivors and activists, we're working together to save lives, empower people, ensure quality care for all and energize science to find the cures.
>
> Thanks to events like the Susan G. Komen Race for the Cure®, and generous contributions from our partners, sponsors and fellow supporters, we have become the largest source of nonprofit funds dedicated to the fight against breast cancer in the world.
>
> Suppose your employer offered to make a donation to Susan G. Komen for the Cure on your behalf if you worked overtime without pay.
>
> What is the maximum number of hours you would be willing to work so that the Susan G. Komen Foundation receives $X?

Participants were either told that Komen would receive $10, $50, $250 or $1250. Participants who are more scope-insensitive to dollars donated to Komen than they are to working overtime would be willing to work fewer hours per dollar as the total donation amount increases. Hence, if the affectively engaging passage increases scope-insensitivity, there would be a significant interaction between donation amount and affective involvement. In particular, the hours per dollar would decline faster over donation amount after reading the affectively engaging passage than the control passage.

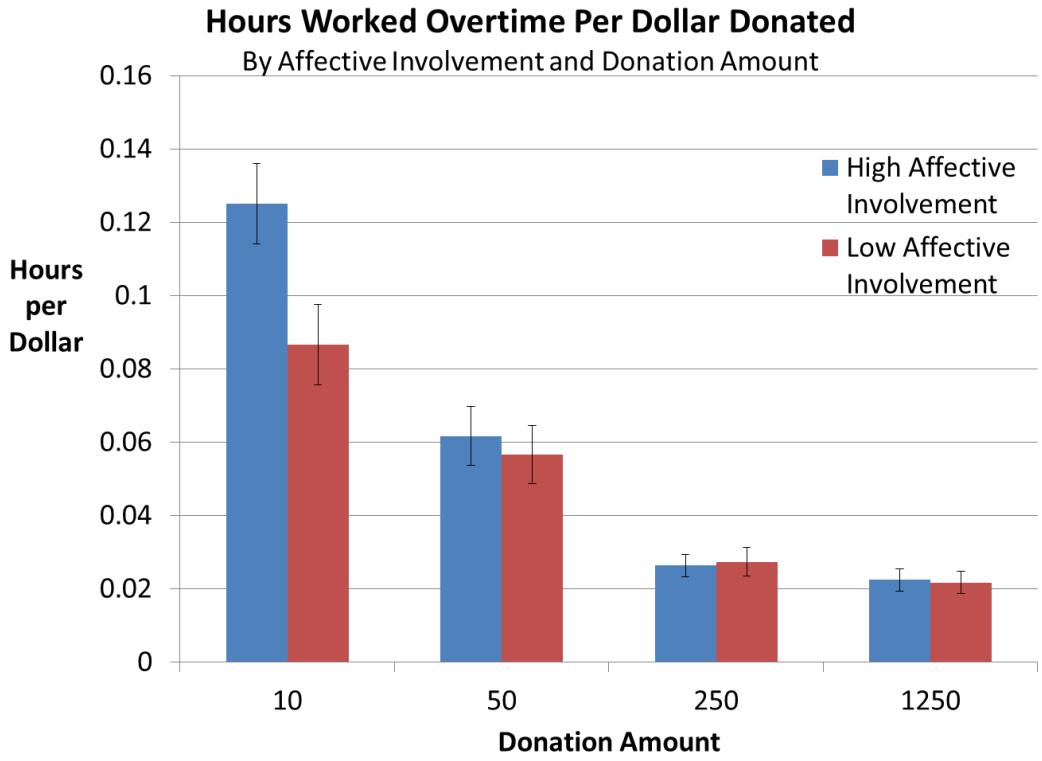
After collecting data on the number of hours participants were willing to work, dollars per hour donated for each participant was computed as $\frac{Hours\ Willing\ to\ Work}{Donation\ Amount}$. Since the self-reported hours were not restricted to a range, outliers that fell outside the interval {Q1-1.5*IQR,Q3+1.5*IQR} were eliminated through a box-and-whisker plot (Tukey 1977). The remaining 308 (95%) of participants reported that they would work, on average 0.05 hours (SD=0.05) per donated dollar.

Figure II-3b shows that manipulating affective involvement with the cause changed scope-insensitivity. To test whether donation amount and affective involvement interacted to

predict hours worked per donated dollar, a profile analysis (2x4 mixed ANOVA), included affective involvement (high vs low) as a between-subjects factor and amount (10, 50, 250, 1250) as a repeated measure. The results indicate that affective involvement increased hours per donated dollar (M_{high} = 0.054, SD = 0.056 vs. M_{low} = 0.048, SD = 0.053; $F(1,300) = 4.67$; p = 0.03). Amount donated also reduced hours per donated dollar (M_{10} = 0.103, SD = 0.070 vs. M_{50} = 0.059, SD = 0.048 vs. M_{250} = 0.027, SD = 0.024 vs. M_{1250} = 0.022, SD = 0.022; $F(3,300) = 59.21$; $p < 0.0001$. Critically, the interaction between affective involvement with the cause and donation amount was significant ($F(3,300)=3.36$; $p=0.02$) which suggests that scope-insensitivity

Figure II-3b. Pretesting Affective Involvement Manipulation

Affective involvement manipulation increases scope-insensitivity to charitable donation.



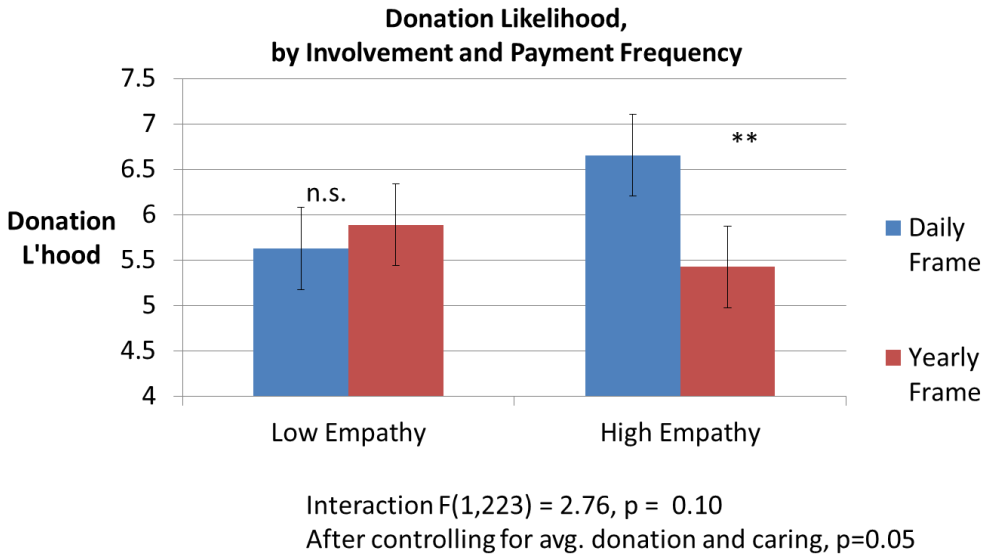
was greater in the condition with high affective involvement with the cause than in the condition with low affective involvement with the cause.

Study 3a Results

As Figure II-3c illustrates, periodic pricing increases likelihood of donating only under the condition with high affective involvement with the cause (high affective involvement: M_{yearly} = 5.9, SD = 3.3 vs. M_{daily} = 5.6, SD = 3.5; $F(1,223) = 0.2$, $p = 0.68$; low affective involvement: M_{yearly} = 5.4, SD = 3.4 vs. M_{daily} = 6.7, SD = 3.3; $F(1,223) = 3.8$, $p = 0.05$; interaction: $F(1,223) = 2.76$, $p < 0.10$).

Figure II-3c. Donation Likelihood, by Affective Involvement and Payment Frequency

Periodic pricing increases donations only under high affective involvement.



Discussion and Overview of Study 3b

Study 3b addresses some possible limitations of the manipulation of scope sensitivity used in Study 3a, which manipulates scope sensitivity by asking participants to read an emotionally-laden passage inducing affective evaluation of a contract's benefits. It is possible that the passage may have manipulated other constructs unrelated to scope insensitivity. Consequently, Study 3b tests the robustness of the findings of Study 3a by manipulating scope-insensitivity using a different methodology. This study also tested whether the results observed thus far replicate under conditions when the participants were not explicitly asked to reflect on the benefits they would receive from the donation.

Study 3b again asked participants to rate their likelihood of making a hypothetical charitable donation, and this time it manipulated scope-insensitivity by presenting some participants with a picture representing the charity's beneficiary alongside each charity description.[28] It was expected, consistent with Hypothesis II-3, that in the presence of the affect-rich picture, participants would be more willing to donate in the daily condition than the yearly condition. On the other hand, if periodic pricing has no effect on how people represent a contract's benefits, the presence of the picture should not change whether periodic pricing leads to a greater willingness to donate. Taken together with Study 3a, an interaction between the presence of the picture and payment frame would offer strong support that periodic pricing affects the representation of a contract's benefits. It would indicate that periodic pricing is most effective when the first unit acquired by a contract provides a disproportionate benefit relative to additional units.

[28] Using pictures as an affect-rich treatment is based on Study 3 of Hsee and Rottenstreich (2004).

Study 3b Method

This study recruited 577 unique online participants[29] from Mechanical Turk to make a decision involving a hypothetical donation to one of four charities. These charities (the only four presented to participants in this study) and their descriptions are included in Appendix II-C. For half of participants, this donation appeal was accompanied by a picture of the cause's beneficiary, while the other half did not include a picture. As before, this donation was presented in a periodic price frame ($1.00 per day) or aggregate price frame ($350 per year), and the survey noted that the hypothetical donation would be automatically deducted from their monthly paycheck and anonymous. Unlike Study 3a, participants were not explicitly asked to reflect on the benefits of the contract. Instead, they were asked to verify the amount requested before moving to the survey page containing the dependent measures, and they were asked an open-ended question "What is the cause being supported by the donation?" Then participants rated the likelihood that they would agree to donate the amount requested, from 0 (not at all likely) to 10 (extremely likely). Finally, participants answered demographics consisting of (and only of) gender, typical yearly donation amount to all causes, age, marital status, income, and education.

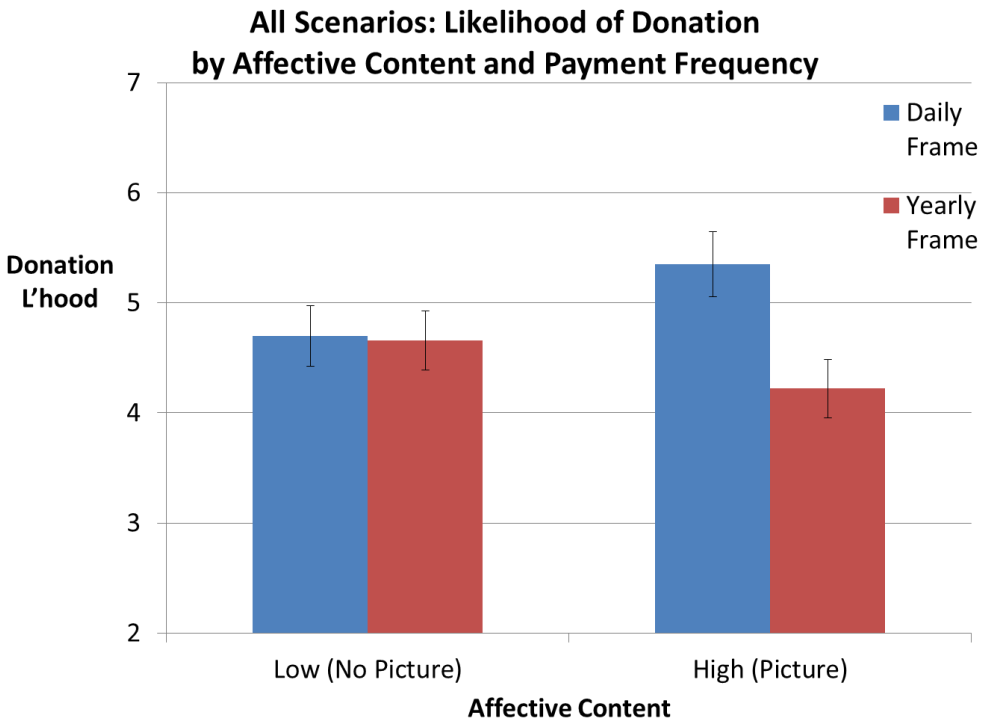
Study 3b Results

Figure II-3d-i summarizes the results across scenarios. Across scenarios, participants are more likely to donate under the periodic pricing frame (yearly vs. daily: $M_{yearly} = 4.2$, SD = 3.2; $M_{daily} = 5.4$, SD = 3.5; $F(1,558) = 4.52$, $p < 0.05$). In an ANOVA analysis, there is no main effect of affective content on donation likelihood ($M_{nopic} = 4.7$, SD = 3.2; $M_{picture} = 4.8$, SD = 3.4;

[29] The data excludes responses from 15 participants (2.6%) who failed one or more of three attention checks. Including these data in the analysis do not substantially change the results.

$F(1,558) = 0.15$, $p = 0.70$). However there is an interaction between affective content and donation likelihood ($M_{yearly\text{-}nopic} = 4.7$, SD = 3.2; $M_{daily\text{-}nopic} = 5.4$, SD = 3.2; $M_{yearly\text{-}pic} = 4.2$, SD = 3.2; $M_{daily\text{-}pic} = 5.4$, SD = 3.5; $F(1,558) = 3.91$, $p < 0.05$). The simple effect of payment frame is significant in the high affect condition ($F(1,558)=8.51$, $p<0.01$) but not in the low affect condition ($F(1,558)=0.01$; $p=0.92$). As Figure II-3d-ii shows, this general pattern of results appears in each of the four scenarios. These results provide corroborate the results form Study 3a finding that more scope-insensitive value functions, such as when affective content of a stimulus is high, increase the likelihood that periodic price framing leads to purchase.

Figure II-3d-i. All Scenarios: Likelihood of Donation by Affective Content and Pay Frequency
Across scenarios, periodic pricing increases donations only when a picture is present.

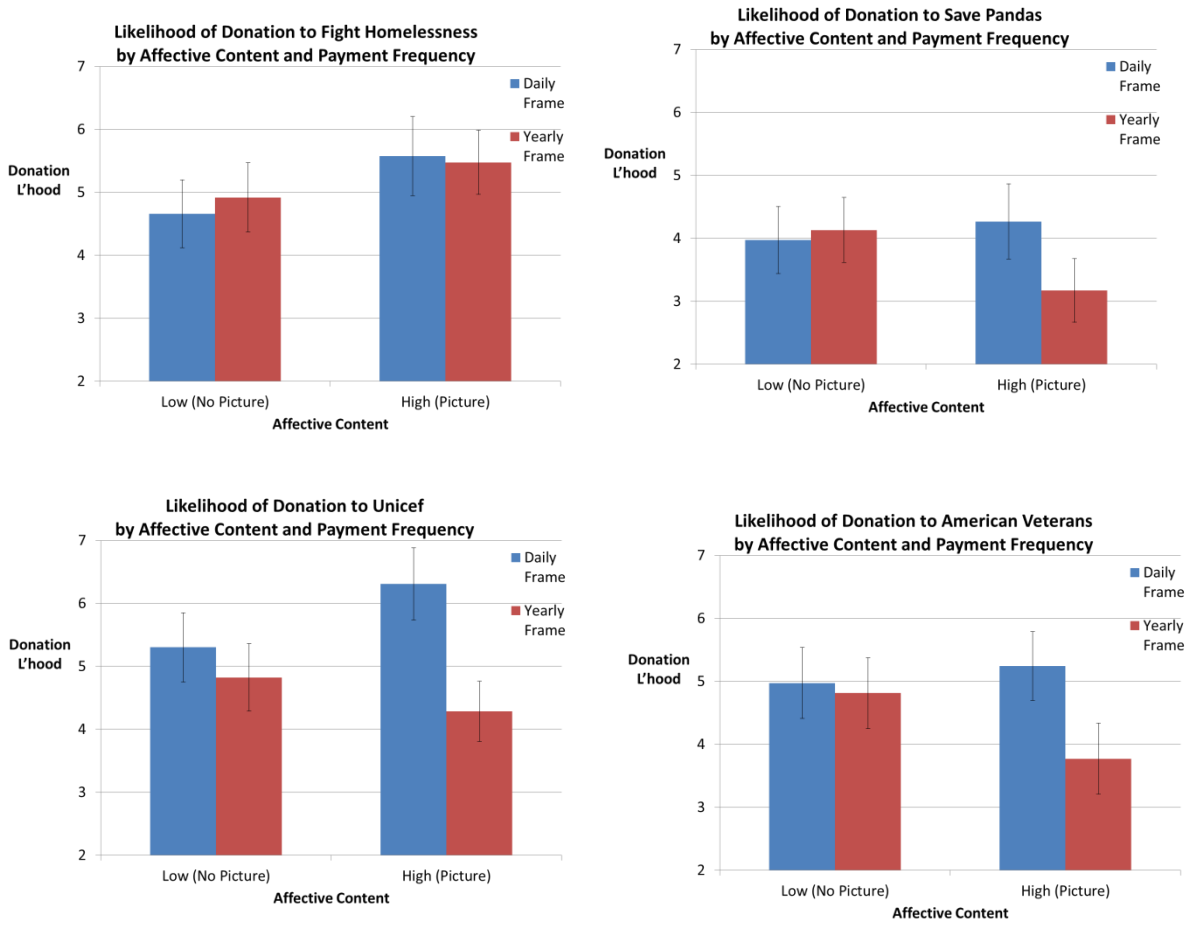


These findings are further supported by additional analysis. First, a variant of the ANOVA model considered the higher-order interactions between payment frame, affect and scenario. These included payment frame X scenario, affect X scenario, and payment frame X affect X scenario. In this model, scenario has a significant main effect ($M_{homeless}$ = 5.1, SD = 3.3; M_{pandas} = 3.9, SD = 3.2; M_{unicef} = 5.2, SD = 3.2; $M_{wounded}$ = 4.7, SD = 3.3; $F(3,546) = 4.93$, $p = 0.002$), but there are no higher-order effects (p's>0. 30). Price frame and the interaction between price frame and affect remain significant (price frame: F(1,546)=5.01, p=0.03; price frame X affect: F(1,546)=4.18, p=0.04). The results indicate that periodic pricing increases purchase likelihood under high affect (F(1,546)=8.66, p<0.01) but not under low affect (F(1,546)=0.01, p=0.92). This pattern of results is virtually identical to that of a model excluding the three-way interaction. It is also does not differ meaningfully from a model including only the main effect of payment frame, affect, their interaction and a scenario main effect.

Additionally, an additional ANCOVA analysis that included payment frame, affect, their interaction, the scenario effect, as well as all collected demographic factors. These include gender (categorical), typical yearly donation amount to all causes (6 categories), age (continuous), marital status (categorical), income (continuous) and education (8 categories). In this model, there is a main effect of gender (F(1,539)=9.59, p=0.002), typical annual donation amount (F(5,539)=6.25, p<0.0001), and education (F(7,539)=1.81, p=0.08). Yet there remains a significant main effect of payment frame on donation likelihood (F(1,539)=4.18, p=0.04), and a marginally significant interaction between payment frame and affect on donation likelihood (F(1,539)=3.51, p=0.06). Turning next to simple effects, participants expressed a greater likelihood of donating to the charity in the daily condition than the yearly condition in the high

affect condition (F(1,539)=9.28, p=0.002) but not in the low affect condition(F(1,539)=0.01, p=0.91).

Figure II-3d-ii. By Scenario: Likelihood of Donation by Affective Content and Pay Frequency



Discussion

Study 3 finds further support for the idea that periodic pricing changes how consumers perceive the contract's benefits. In particular there is evidence that periodic pricing is effective when participants are scope-insensitive to a contract's benefits, in support of Hypothesis II-3. By manipulating affective involvement with the target product in two ways, Study 3 is able to provide more insight what conditions make periodic pricing most relevant to practitioners while

providing initial insight into how periodic pricing works. Study 3 suggests that periodic pricing works well for scope-insensitive product categories and for modes of presentation that increase scope-insensitivity. This further suggests that periodic pricing encourages consumers to generalize an instance of a contract's benefits to the entire payment period.

The present framework posits that, following per-day pricing, the first unit of consumption is relied on more for general assessments of the contract, which for more scope-insensitive goods, produces a positive net effect. This offers another differentiation from the classic pennies-a-day framework, which has no prediction about how affective involvement would influence willingness to purchase. Study 4 explores the specific mechanisms underlying this account.

Study 4. Which Benefits Increase?

Overview

The fourth study further explores when periodic pricing is effective and, through supporting process data, provides further insight into the underlying cognitive changes when narrow costs amplify perceived benefits. This study explores differences in how periodic and aggregate price frames call to mind different representations of a proposed contract's benefits.

Narrowly framed periodic pricing could magnify a contract's benefits through one of two possible routes. First, periodic pricing could increase the extent to which a representative periodic benefit gets generalized across payments (consistent with Hypothesis II-4). In this case, the "first day" driving a car is generalized across all days with the car, which increases the evaluation of the other days. Alternatively, periodic pricing could magnify how consumers evaluate a single representative benefit, such as by drawing their attention to the excitement of

the first day with the car. Under this alternate hypothesis, narrow periodic pricing would make the first day driving the car seem better, but it would not affect how the other days are perceived.

The fourth study collects process evidence to better understand which of these two accounts best explains the results. Another goal of this study is to test whether the observed differences in perceived benefits arise only because participants were explicitly asked to think about the contract's benefits.

Method

In this study 95 Mechanical Turk participants were asked to make a decision about a hypothetical donation to Unicef. A description of the charity was presented, and the donation was requested in a periodic price frame ($2.50 per day) or aggregate price frame ($900 for the year). Whereas previous studies asked participants to specifically think about the contract's benefits, in this study participants were asked to "pause for a moment to think through the decision about whether or not to donate. Please make a list of all of the complete thoughts you have about this decision. You may enter up to 10 thoughts." Participants then rated, on a 0-10 scale, how likely they would donate, and how satisfied they expected to be on the most and least satisfying day if they agreed to the contract. Finally, participants categorized their own thoughts as either advantages or disadvantages of donating in a process similar to the aspect listing and rating protocol used by Johnson et al. (2007). As before, the survey explicitly stated that the hypothetical donation would be automatically deducted from their monthly paycheck. The data excluded participants who incorrectly answered the donation frequency attention check question.

Results

The data suggests that participants are more likely to donate under the periodic pricing frame (yearly vs. daily: $M_{yearly} = 4.9$, SD = 3.1; $M_{daily} = 6.8$, SD = 3.1; $F(1,93) = 8.46$, $p < 0.01$). Participants also list more advantages under the periodic pricing frame (yearly vs daily: $M_{yearly} = 1.7$, SD = 1.6; $M_{daily} = 2.4$, SD = 1.6; $F(1,93) = 5.25$, $p = 0.03$) but an equivalent number of disadvantages ($M_{yearly} = 1.7$, SD = 1.2; $M_{daily} = 1.5$, SD = 2.0; $F(1,93) = 0.16$, $p = 0.69$). The data further indicate that the donation period's least pleasurable day is rated more highly under the periodic pricing frame than the aggregate pricing frame ($M_{yearly} = 2.4$, SD = 2.5; $M_{daily} = 3.6$, SD = 2.8; $F(1,93) = 4.58$, $p = 0.03$). In contrast, there were no difference in expectations about the most satisfying day ($M_{yearly} = 7.3$, SD = 2.7; $M_{daily} = 7.0$, SD = 2.7; $F(1,93) = 0.32$, $p = 0.57$).

Discussion

Study 4 finds evidence that per-day pricing changes how consumers represent the benefits associated with periodic payments. Under the narrow periodic pricing frame, participants rated their satisfaction on the worst day more highly. In contrast, pricing frame had no effect on how participants rated their satisfaction on the best day. This is evidence consistent with Hypothesis II-4, namely, that periodic pricing helps extend projected benefits, rather than increase the peak projected experience. This suggests that per-day pricing imposes a structure that helps consumers make a stream of future intangible events more salient.

Study 4 also addresses a possible limitation of previous studies. The study finds results consistent with previous studies even though participants were not asked to consider the contract's benefits. This leads us to be confident that the results are not an artifact of that feature

of previous studies. Study 5 builds on this design feature to provide further insight into the psychological mechanisms that cause periodic pricing to increase purchase likelihood.

Study 5. Not Just Pennies, Redux

Overview

The fifth study revisits the general framework of Study 2 to better understand why narrow periodic price frames increase purchase intentions by assessing several possible explanations. Hypothesis II-4 predicts that the periodic price frame improves extends favorable evaluations of the most valued consumption periods to less desirable consumption periods (i.e. last day and anticipated worst day).

There are several alternative explanations that are explored in this study. First, it is possible that narrow periodic pricing could make the first or best day seem better due to increased attention to that day. Additionally, although this result would not necessarily be predicted, it is possible that the narrow periodic price frame could encourage consumers to adopt a lower level construal (Trope and Liberman 2010; Fiedler 2007). A lower level construal could potentially make the contract seem more or less attractive, depending on which features of the contract are represented in the low-level construal. Finally, the effects could result from cognitive capacity limitations or financial literacy limitations, which both could differentially impact narrow and broad periodic price framing. In addition to assessing these competing explanations, this study removes the prompt for consumers to think about or report the benefits associated with the contract. This allows testing whether periodic pricing expands perceived benefits under more general circumstances.

Method

In this study, 321 Mechanical Turk participants completed a questionnaire that was broadly similar to Study 2. As before, participants were told about an opportunity to lease one of several luxury vehicles. Although everyone was evaluating a 36-month lease that involved payments that would be automatically deducted from his or her monthly paycheck, this cost was framed as either $20 per day (periodic price frame) or $7,250 per year (aggregate price frame). Participants were then asked for the likelihood that they would agree to pay the amount requested, on a scale from 0 (not at all likely) to 10 (extremely likely).

After completing the main choice task, participants first completed two blocks of questions that helped determine whether narrow periodic pricing improved the first/best day, last/worst day, or changed their construal level. The first component asked participants to rate, "If you agreed to the amount requested, how satisfied do you expect to be on…" four different days. These included the first day, the most satisfying day over the next year, the last day, and the least satisfying day over the next year. Each of these were answered on 11-point scales ranging from 0 (not at all satisfying) to 10 (extremely satisfying) and they were presented in random order. Additionally, construal level was assessed using a short-form (4-item) behavioral identification form, and these two components were presented in random order.

Finally, participants completed a short-form (4-item) financial/debt literacy scale and short-form (5-item) numerical reasoning scale. All scales were developed on the basis of pretest data that used a sample similar to the test pool. Details on scale construction appear in Appendix II-D. In the main experiment, the scales were presented in random order and the items within each scale were randomized.

Results

Analyses of possible alternative influences on purchase intentions. Neither numerical ability, financial literacy, nor purchase intentions were expected to be affected by the payment frame. These were also not expected interact with the payment frame to influence consumers' purchase intentions. Neither numerical ability nor financial literacy varied across conditions (yearly vs. daily frame; *F*s(1,319) <= 1), and separate ANOVAs found that neither interacted with frame to influencing purchase intentions (*F*s(1,317) = 0.03). However, individual differences in numerical ability and financial literacy each predicted purchase intentions (numerical ability: $F(1,317) = 6.69$, $p = 0.01$; financial literacy: $F(1,317) = 15.26$, $p = 0.001$).

There were no specific predictions about how construal level would relate to purchase intentions. The results suggest that level of abstraction did not differ across conditions ($F(1,319) < 1$). There was also no main effect of construal level on purchase intention, and no interaction between frame and construal level ($F(1,317) < 1$).

Analyses of the role of anticipated benefits on purchase intentions. Next, analysis turns to the relationship between payment frame and evaluations of particular days, and how those ratings accounted for the relationship between payment frame and purchase intentions. The price frame influenced satisfaction on the least satisfied and last day (least: $M_{yearly} = 3.26$, SD = 2.56; $M_{daily} = 3.78$, SD = 2.54; $F(1,319) = 3.42$, $p = 0.07$; last: $M_{yearly} = 6.86$, SD = 2.92; $M_{daily} = 7.49$, SD = 2.64; $F(1,319) = 4.09$, $p = 0.04$) but not the most satisfied nor first day (most: $M_{yearly} = 8.43$, SD = 1.76; $M_{daily} = 8.55$, SD = 1.87; $F(1,319) = 0.32$, $p = 0.57$; first: $M_{yearly} = 7.63$, SD = 2.31; $M_{daily} = 7.86$, SD = 2.40; $F(1,319) = 0.78$, $p = 0.38$). In a regression, these daily ratings, considered jointly, each predicted purchase intentions ($\beta_{most} = 0.34$, SE = 0.09, $p < 0.001$; $\beta_{least} = 0.46$, SE = 0.06, $p < 0.001$; $\beta_{first} = 0.22$, SE = 0.07, $p = 0.002$; $\beta_{last} = 0.24$, SE = 0.05, $p <$

0.001)[30]. Controlling for financial literacy, numeracy and level abstraction, the daily ratings again each predict purchase intentions (β_{most} = 0.40, SE = 0.10 , $p < 0.001$; β_{least} = 0.43, SE = 0.06, $p < 0.001$; β_{first} = 0.20, SE = 0.07, $p = 0.004$; β_{last} = 0.21, SE = 0.06, $p < 0.001$). In that regression, financial literacy predicts purchase intentions but abstraction and numerical ability do not (β_{flit} = -1.31, SE = 0.52, $p = 0.01$; β_{abst} = -0.32, SE = 0.42, $p = 0.45$; β_{num} = -0.05, SE = 0.55, $p = 0.93$).

Next the analysis evaluated the indirect effect of payment frame on purchase intention as mediated through the four day ratings. This series of equations also included level of abstraction as a mediator, and controlled for financial literacy and numerical ability. Indirect effects were calculated based on coefficients for simultaneously estimated SUR regressions, bootstrapping 5000 times. As shown in Figure II-4, ratings of the last day and least day directionally mediated the relationship between payment frame and purchase intentions (β_{last} = 0.13, 95% CI = {-0.02, 0.27}, $p < 0.10$; β_{least} = 0.22, 95% CI = {-0.03, 0.47}, $p = 0.08$). The first day, best day and level of abstraction each did not mediate the relationship between payment frame and purchase intentions (β_{first} = 0.05, 95% CI = {-0.07, 0.16}, $p = 0.43$; β_{best} = 0.05, 95% CI = {-0.12, 0.21}, $p = 0.59$). These factors together fully mediated the effect of payment frame on purchase intentions. A second mediation model additionally controlled for numerical ability in the effect of the payment frame on the daily ratings and abstraction. In this model, the indirect effects remained roughly similar in size but the indirect effect of the last day and least satisfying day strengthened statistically (β_{last} = 0.14, 95% CI = {-0.01, 0.28}, $p = 0.07$; β_{least} = 0.25, 95% CI = {0.00, 0.49}, $p < 0.05$).

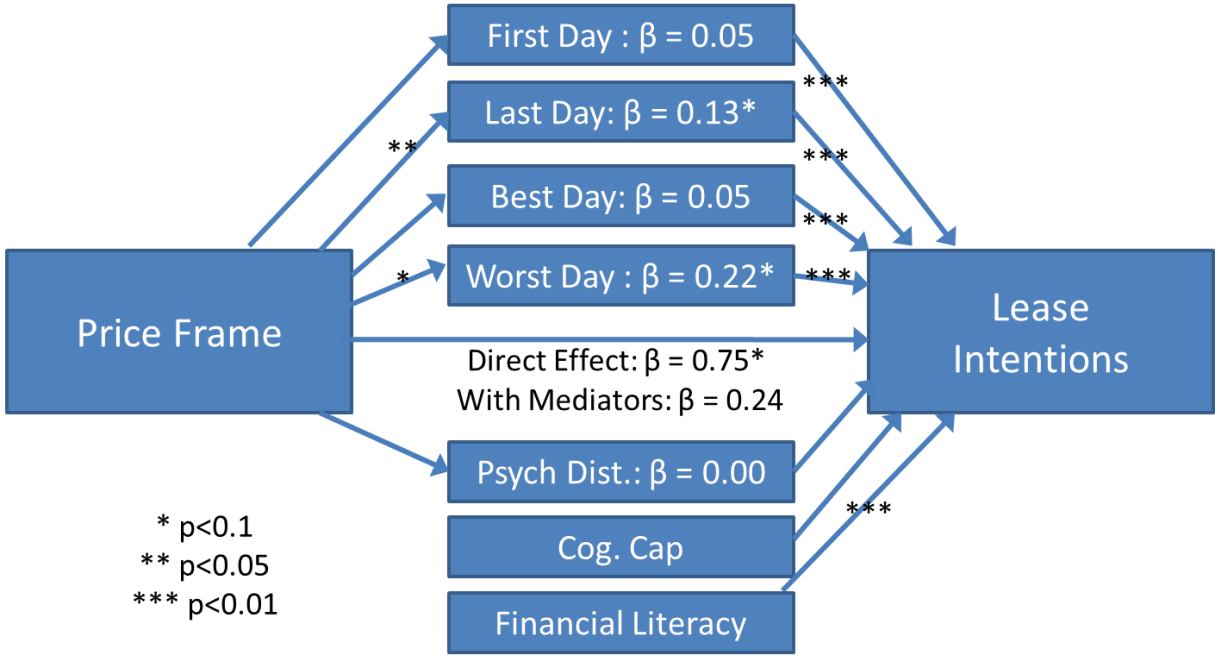
[30] The variance inflation factors for these regression coefficients provides an indication about whether there is a valid concern regarding multicollinearity. These inflation factors were all low (all below 1.5) and are consequently multicollinearity is not a concern.

Discussion

Study 5 replicates the results of Study 2 without the explicit prompt to think about or report benefits. In other words, consumers spontaneously think about the contract's benefits differently following a periodic or aggregate price frame. Consequently, an explicit prompt to think about the contract's benefits is not necessary for narrow periodic pricing to increase contract compliance in the non-trivial cost domain.

Figure II-4. Mediating Payment Frame and Lease Intentions, Redux

Daily price frame increases lease intentions by improving perceptions of last, least day.



Joint estimation of simultaneous equations (SUR); bootstrapped with 5000 replications.
(Method discussed by Preacher & Hayes, 2008)

Additionally, Study 5 provides further evidence in support of Hypothesis II-4 over several plausible alternate explanations. Narrowly-framed periodic prices increase purchase likelihood by improving how consumers perceive the least desirable and temporally distant days rather than by improving how they perceive the most desirable and imminent days. This is

consistent with consumers extending their per-day product evaluation across all days rather than by improving the evaluations of immediately accessible days. The evidence also suggests that the observed periodic pricing effects do not happen because of a change in overall construal level or apply to only concrete or abstract thinkers. Further, neither numerical ability nor financial literacy can account for consumers' improved contract evaluations following narrow periodic pricing. Finally, such periodic pricing effects are not constrained to only individuals with low or high numerical ability or financial literacy. This evidence suggests that the effect of narrow periodic pricing on contract evaluations is likely not driven by peculiarities of the sample and rules out several alternate explanations.

General Discussion

This essay proposes a novel account of why consumers agree to contracts when the price is framed as a series of periodic payments. Previous accounts have focused on how periodic costs are affordable only if a representative cost assimilates with the set of small, recurring expenses. The data supplements and extends this model, finding that framing a contract's tangible cost narrowly (e.g. per-day pricing) causes consumers to represent corresponding intangible benefits narrowly, and this often magnifies the contract's benefits. In addition to offering a novel account of the pennies-a-day phenomenon, the new account predicts cases when periodic pricing fails to increase purchase despite having a trivial cost as well as when periodic pricing succeeds despite non-trivial periodic payments.

The data provide empirical support for some new predictions that cannot be explained through the extant pennies-a-day paradigm. First, narrowly framing a contract's price doesn't only make the price appear insignificant, but also encourages consumers to anticipate greater

benefits from the contract. There is also evidence that the greater anticipated benefits are not explained by decreased price perceptions. Next, the results suggest that the effects of periodic pricing are *not* restricted to the domain of trivial costs.

The third study identifies when periodic pricing increases purchase likelihood by considering the role of scope-insensitivity: narrow framing works when the first unit carries the greatest benefit. Finally, process evidence provides an understanding of how per-day pricing changes the representation of future benefits associated with the periodic payments. There is evidence that periodic pricing improves how consumers perceive overlooked consumption events rather than increasing focal consumption events. The new findings are consistent with previous findings that consumers are sensitive to the size of a set when set size information is salient and interpretable, and consumers pay attention to it (Kahneman, Ritov and Schkade 1999).

The results violate the concept of "descriptive invariance" from standard economic theory, which predicts that different descriptions of the same stimuli should not affect preferences (Tversky, Sattath and Slovic 1988). Additionally, the results provide evidence that the valuation of gains and losses are not separable, in violation of a core assumption of Prospect theory (Kahneman and Tversky 1979) and Cumulative Prospect theory (Tversky and Kahneman 1992). Similar separability violations have been found for decisions involving risk (Wu and Markle 2008).

The current results are generally consistent with the notion that tightly coupling payments with consumption provides hedonic value but it is not clear whether such framing improves decision quality. The results support the notion that pain of paying is offset when thinking about payments calls to mind thoughts about benefits (Prelec and Loewenstein 1998). The tight coupling of periodic pricing may support better decisions if the benefits evoked under a narrow

frame better represent a consumer's "true" preferences—e.g., preferences for products consumed daily where less satiation occurs than consumers expect. This research is agnostic as to which elicitation procedure gives rise to normatively correct responses.

Future research could extend this research to test an extension of the theory proposed here. The present work focuses on contracts involving benefits that are relatively scope-insensitive, yet consumers vary in their scope-insensitivity to payments according to individual differences (Tanaka, Camerer, and Nguyen 2010) and contextual factors (Hsee, Rottenstreich and Xiao 2005). In cases where people are more scope-insensitive to payments than the commensurate benefits, reframing a cost as periodic payments may backfire.

Managerial Implications

This research offers novel insights for marketing managers who seek guidance about when to present prices as periodic. Previous research suggests that periodic prices should only be used when the resulting price calls to mind a trivial amount of money. In contrast, this research suggests that regardless of cost triviality, framing price as a recurring event over time helps consumers appreciate the large benefits from products or services that offer many recurring small benefits. Consequently, marketers should not limit themselves to framing prices on a per-day basis when the resulting payment is seen as trivial, and can instead use periodic prices as a general strategy across price levels.

This research also offers guidance about when periodic pricing is most effective. Marketers should use periodic prices whenever they expect that consumers will value the first few consumption events more highly than other consumption events. This pattern is likely to fit (a) for highly emotional product categories, (b) when accompanied by with emotional appeals to

use a product or service, and/or (c) when marketers expect consumers to quickly satiate to a product. Additionally, it is likely to fit (d) when marketers anticipate that their target customers lack the ability or context to fully appreciate the full magnitude offered by a product or service contract that extends over time or across many units. Under these conditions, periodic pricing presented in conjunction with emphasis on the highly valued unit can encourage consumers to generalize the value they place on that event to other, less highly valued events.

4

General Discussion

Summary of Results

This dissertation investigates how consumers evaluate consumer financial decisions with consequences that recur over time. Recurring financial consequences differ from one-time events in that the consequences are explicitly distributed across time. The dissertation first explores the role of individual differences in intertemporal preferences in this domain, and then investigates how consumers account differently for recurring and one-time financial events. The two essays together suggest that contracts involving recurring financial events are mentally represented differently from those with one-time financial events, and that content is then discounted based on intertemporal preferences.

The first essay examines the relationship between intertemporal preferences and mortgage choices. This project augments a survey of 244 mortgaged homeowners with zip code level data on the local housing market to examine how present bias and exponential discounting relate with mortgage choices leading to negative home equity and strategic once underwater. It finds that both present bias and exponential discounting lead to negative home equity, and while exponential discounting encourages homeowners to walk away once underwater, present bias leads them to resist strategic default. These results are robust to several controls including components of risk preferences, individual and market-level controls and several alternate model specifications. These findings are further reinforced by evidence, in both the survey and a reference data set, that intertemporal preferences also relate with several precursors of underwater mortgages, net home equity and net worth. Additional analysis casts doubt on a number of alternate explanations.

The second essay examines how consumers view a transaction's benefits differently when its cost is framed as a recurring expense compared with a single expense. This essay

proposes and finds that recurring costs tend to encourage consumers to "book" a transaction's recurring benefits more frequently. So when consumers are insensitive to scope for the transaction's benefits, they tend to view a transaction as having more benefits if the price is framed on a recurring basis.

Together, these essays suggest that individual differences and situational cues influence decisions involving recurring financial events. In particular, understanding intertemporal preferences provide useful and nuanced insight into these decisions. But to understand how these individual differences will impact how consumers react to a proposed contract, marketers must understand the meaning consumers attach to the financial events. So, for example, when evaluating a mortgage, consumers are thinking not only of the financial consequences but also of the hardship to their families from having to move in the short run. Taken in context, the choice of whether to present a recurring financial event or its aggregate equivalent itself influences how consumers make choices in this domain, and marketers should choose the frame carefully.

Future Research Directions

There are a number of open research questions related to the topics pursued in this dissertation. Using behavioral models is a growing area in consumer finance, and incorporating individual differences of time preferences into models of financial decision making provides opportunities to develop financial products that segment and/or target consumers. Understanding time preferences are most valuable however, with a complete picture of the meaning consumers affix to financial events (e.g. v(x) in equation I-2), and future research should examine not only time preferences in other financial domains but also develop new methods to understand how consumers characterize and categorize financial events.

Another open research area is to better understand when is "now." Essay I applies a quasihyperbolic discounting function because it fits differences in consumer preferences well while requiring only a single additional parameter. Quasihyperbolic discounting models have, however, ranged dramatically in what period comprises "now." For example, Laibson (1997) and Angeletos et al. (2001) estimate a present bias that discounts all consumption after *this year*, while Tanaka et al (2010) estimate a present bias that discounts all consumption after *today*. This difference was not important in the present research because it treats the elicited intertemporal preferences as summaries of more complex cognitive processes. However, future research should examine this more closely, as just as there have been differences between researchers in how to conceptualize "now", there may be relevant individual differences in and contextual influences on the time frame considered to be "now," and this may be an important factor in consumer financial decisions.

Another future research direction is how the recurring and one-time financial events cause different content to be recalled from memory. For example, it may be interesting to examine the results of the Essay II in the context of Query theory (Johnson et al. 2007; Weber et al. 2007). Query theory posits that contextual cues influence how preferences are constructed because initial thoughts interfere with the recall of subsequent thoughts. The results from this essay are consistent with an account where the contextual cues influence the initial queries (such as thoughts about a transaction's total or periodic costs) which alter later queries (leading to thoughts about a transaction's total or periodic benefits). Collecting and evaluating the content, order and frame of thoughts would enable further exploration of this research in the context of Query theory. More broadly, measuring the accessibility of daily/yearly benefits following the

presentation of daily/yearly costs would help demonstrate that the cost frame is used as a cue for how to mentally account for prospective benefits.

Essay II also suggests a wide range of research directions outside the scope of this dissertation. For example, in theory the prediction that more frequent payment events increases purchase will reverse when consumers are more scope insensitive to the transaction's costs than they are to the transaction's benefits. For example, if consumers are evaluating a transaction involving highly emotional costs and calculable benefits, consumers may evaluate the transaction more highly under an aggregate frame. Additionally, the present research is limited to prospective evaluations, and further work could explore how periodic pricing influences retrospective evaluations by explicitly adding a knowledge/memory component to the model.

Conclusion

In closing, this dissertation examined the role of two factors in how consumers evaluate financial decisions with consequences that recur over time, which by nature are consequential to consumer welfare. First this dissertation explores how individual differences in intertemporal preferences influence consumer choices in this domain. The second essay explores how event frequency changes what consumers bring to mind about a contract, independent from their intertemporal preferences. Consequently, the decision of whether to present financial events from periodic prices to annuitized payments must consider both the change to when the payment events occur and how consumers represent the payment events.

5. References

Ainslie, George, “Specious Reward: A Behavioral Theory of Impulsiveness and Impulse Control,” Psychological Bulletin, 82 (1975), 463-496.

Andersen, Steffen, Glenn W. Harrison, Morten L. Lau, and Elisabet E. Rutstrom, "Estimating Risk and Time Preferences," Econometrica, 76 (2008), 583-618.

Angeletos, George-Marios, David Laibson, Andrea Repetto, Jeremy Tobacman, and Stephen Weinberg, "The Hyperbolic Consumption Model: Calibration, Simulation, and Empirical Evaluation," The Journal of Economic Perspectives, 15 (2001), 47-68.

Ashraf, Nava, Dean Karlan, and Wesley Yin, "Tying Odysseus to the Mast: Evidence from a Commitment Savings Product in the Philippines," Quarterly Journal of Economics, 40 (2006), 635-672.

Baron, Jonathan, and Joshua Greene, "Determinants of insensitivity to quantity in valuation of public goods: Contribution, warm glow, budget constraints, availability, and prominence," Journal of Experimental Psychology: Applied, 2 (1996), 107-125.

Benhabib, Jess, Alberto Bisin, and Andrew Schotter, "Present-Bias, Quasi-Hyperbolic Discounting, and Fixed Costs," Games and Economic Behavior, 69 (2010), 205-223.

Bernartzi, S., and R. H. Thaler, “Myopic Loss Aversion and the Equity Premium Puzzle,” Quarterly Journal of Economics, 110 (1995), 75-92.

Browning, Martin and Jeremy Tobacman, "Discounting and Optimism Equivalences," (2007).

Bucks, Brian, and Karen Pence, "Do Borrowers Know Their Mortgage Terms?" Journal of Urban Economics, 64 (2008), 218-233.

Campbell, John Y., and João F. Cocco, "Household Risk Management and Optimal Mortgage Choice," Quarterly Journal of Economics, 118 (2003), 1449-1494.

Campbell, John Y., and João F. Cocco, "A Model of Mortgage Default," National Bureau of Economic Research Working Paper Series, No. 17516 (2011).

Carroll, G.D., J.J. Choi, D Laibson, B.C. Madrian, and A. Metrick, "Optimal Defaults and Active Decisions," Quarterly Journal of Economics, 124 (2009), 1639-1674.

Chabris, Christopher F., David Laibson, Carrie L. Morris, Jonathon P. Schuldt, and Dmitry Taubinsky, "Individual Laboratory-Measured Discount Rates Predict Field Behavior," Journal of Risk and Uncertainty, 37 (2008), 237-269.

Chapman, Gretchen B., "Temporal Discounting and Utility for Health and Money," J Exp Psychol Learn, 22 (1996), 771-791.

DellaVigna, Stefano , and Ulrike Malmendier, "Contract Design and Self-Control: Theory and Evidence," The Quarterly Journal of Economics, 119 (2004), 353-402.

DellaVigna, Stefano and Ulrike Malmendier, "Paying Not to Go to the Gym," American Economic Review, 96 (2006), 694-719.

DellaVigna, Stefano, and M. Daniele Paserman, "Job Search and Impatience," Journal of Labor Economics, 23 (2005), 527-588.

Desvousges, William H., Institute Research Triangle, and Corporation Exxon, Measuring nonuse damages using contingent valuation : an experimental evaluation of accuracy (Research Triangle Park, N.C.: Research Triangle Institute], 1992).

Eigsti, Inge-Marie, Vivian Zayas, Walter Mischel, Yuichi Shoda, Ozlem Ayduk, Mamta B. Dadlani, Matthew C. Davidson, J. Lawrence Aber, and B.J. Casey, "Predicting Cognitive

Control From Preschool to Late Adolescence and Young Adulthood," Psychological Science, 17 (2006), 478-484.

Federal Reserve, "Part 2: Recent Economic and Financial Developments," Monetary Policy Report to the Congress, Washington: Board of Governors of the Federal Reserve System, (2012a), July 17.

Federal Reserve, "The U.S. Housing Market: Current Conditions and Policy Implications, White Paper, (2012b) [http://www.federalreserve.gov/publications/other-reports/files/housing-white-paper-20120104.pdf], Accessed on 10/26/2012.

Fiedler, Klaus, "Construal Level Theory as an Integrative Framework for Behavioral Decision-Making Research and Consumer Psychology," Journal of Consumer Psychology, 17 (2007), 101-106.

Figner, Bernd, Daria Knoch, Eric J. Johnson, Amy R. Krosch, Sarah H. Lisanby, Ernst Fehr, and Elke U. Weber, "Lateral Prefrontal Cortex and Self-Control in Intertemporal Choice," Nature Neuroscience, 13 (2010), 538-539.

Foote, Christopher L., Kristopher Gerardi, and Paul S. Willen, "Negative Equity and Foreclosure: Theory and Evidence," Journal of Urban Economics, 64 (2008), 234-245.

Frederick, Shane, "Cognitive Reflection and Decision Making," Journal of Economic Perspectives, 19 (2005), 25-42.

Frederick, Shane, Personal Communication, Yale School of Management, US, (2012).

Frederick, S., and B. Fischhoff, "Scope (in) sensitivity in elicited valuations," Risk Decision and Policy, 3 (1998), 109-123.

Frederick, Shane, George Loewenstein, and Ted O'Donoghue, "Time Discounting and Time Preference: A Critical Review," Journal of Economic Literature, 40 (2002), 351-401.

Frederick, Shane, Nathan Novemsky, Jing Wang, and Ravi Dhar, “Opportunity Cost Neglect,” Journal of Consumer Research, 36 (2009), 553-561.

Genesove, D, and C Mayer, "Loss Aversion and Seller Behavior: Evidence from the Housing Market*," Quarterly Journal of Economics, 116 (2001), 1233-1260.

Gilpatric, Scott M., “Slippage in Rebate Programs and Present-Biased Preferences,” Marketing Science, 28 (2009), 229-238.

Gourville, John T., "Pennies-a-Day: The Effect of Temporal Reframing on Transaction Evaluation," The Journal of Consumer Research, 24 (1998), 395-408.

Gourville, John T., "The Effect of Implicit versus Explicit Comparisons on Temporal Pricing Claims," Marketing Letters, 10 (1999), 113-124.

Gourville, John T., "The Effects of Monetary Magnitude and Level of Aggregation on the Temporal Framing of Price," Marketing Letters, 14 (2003), 125-135.

Graham, John R., and Campbell R. Harvey, "The Theory and Practice of Corporate Finance: Evidence from the Field," Journal of Financial Economics, 60 (2001), 187-243.

Guiso, Luigi, Paola Sapienza, Luigi Zingales, "The Determinants of Attitudes towards Strategic Default on Mortgages," (2010).

Hausman, Jerry, “Individual Discount Rates and the Purchase and Utilization of Energy-Using Durables,” Bell Journal of Economics, 10 (1979), 33-54.

Harrison, Glen W., Morten I. Lau and Melonie B. Williams, “Estimating Individual Discount Rates in Denmark,” American Economic Review, 92 (2002), 1606-1617.

Heidhues, Paul, and Botond Koszegi, "Exploiting Naivete about Self-Control in the Credit Market," American Economic Review, 100 (2010), 2279-2303.

Hsee, CK, Y Rottenstreich, and Z Xiao, "When Is More Better?," Current Directions in Psychological Science, 14 (2005), 234.

Hsee, Chrisopher K., George F. Loewenstein, Sally Blount, and Max H. Bazerman, "Preference reversals between joint and separate evaluations of options: A review and theoretical analysis," Psychological Bulletin, 125 (1999), 576-590.

Hsee, Christopher K., and Yuval Rottenstreich, "Music, Pandas, and Muggers: On the Affective Psychology of Value," Journal of Experimental Psychology: General, 133 (2004), 23-30.

Johnson, E. J., G. Haubl, and A. Keinan, "Aspects of endowment: A query theory of value construction," Journal of Experimental Psychology-Learning Memory and Cognition, 33 (2007), 461-474.

Johnson, Eric J., and Christopher Mayer, "2/28 Mortgages: When Business and Psychology Intersect in New Consumer Products," (New York: Columbia CaseWorks, Columbia Business School, Columbia University, 2011).

Kable, Joseph W., and Paul W. Glimcher, "The Neural Correlates of Subjective Value During Intertemporal Choice," Nature Neuroscience, 10 (2007), 1625-1633.

Kahneman, Daniel, and Jack L. Knetsch, "Valuing public goods: The purchase of moral satisfaction," Journal of Environmental Economics and Management, 22 (1992), 57-70.

Kahneman, Daniel, Ilana Ritov, and David Schkade, "Economic Preferences or Attitude Expressions?: An Analysis of Dollar Responses to Public Issues," Journal of Risk and Uncertainty, 19 (1999), 203-235.

Kahneman, D., and A. Tversky, "Prospect Theory - Analysis of Decision under Risk," Econometrica, 47 (1979), 263-291.

Kirby, Kris N., and R.J. Herrnstein, "Preference Reversals Due to Myopic Discounting of Delayed Reward," Psychological Science, 6 (1995), 83-89.

Krueger, Lester E., "Reconciling Fechner and Stevens: Toward a unified psychophysical law," Behavioral and Brain Sciences, 12 (1989), 251-267.

Laibson, David, "Golden Eggs and Hyperbolic Discounting," Quarterly Journal of Economics, 112 (1997), 443-477.

Lambrecht, Anja and Catherine Tucker, "Paying With Money or With Effort: Pricing When Customers Anticipate Hassle," Journal of Marketing Research, 49 (2012), 66-82.

Linville, Patricia W., and Gregory W. Fischer, "Preferences for separating or combining events," Journal of Personality and Social Psychology, 60 (1991), 5-23.

Lipkus, Isaac M., Greg Samsa, and Barbara K. Rimer, "General Performance on a Numeracy Scale among Highly Educated Samples," Medical Decision Making, 21 (2001), 37-44.

Loan Value Group, "Loan Value Group Launches RHReward.com to Educate Responsible Homeowners on New Reward Program," (http://www.marketwire.com/press-release/Loan-Value-Group-Launches-RHRewardcom-Educate-Responsible-Homeowners-on-New-Reward-Program-1135309.htm), (2010).

Loewenstein, George F., "Frames of Mind in Intertemporal Choice," Management Science, 34 (1988), 200-214.

Loewenstein, George F., and Sicherman, N. "Do Workers Prefer Increasing Wage Profiles?" Journal of Labor Economics, 9, 67-84.

Loewenstein, George F., and Richard. H. Thaler, "Anomalies - Intertemporal Choice," Journal of Economic Perspectives, 3 (1989), 181-193.

Lusardi, Annamaria, and Peter Tufano, "Debt Literacy, Financial Experiences, and Overindebtedness," National Bureau of Economic Research Working Paper Series, No. 14808 (2009).

Lusardi, Annamaria, and Olivia S. Mitchell, "Financial Literacy and Planning: Implications for Retirement Wellbeing," National Bureau of Economic Research Working Paper Series, No. 17078 (2011).

Machado, Fernando, and Rajiv K. Sinha (2007), "Smoking Cessation: Planned versus Actual Behavior for Time-Inconsistent Consumers," Marketing Sceience, 26 (2007), 834-850.

Mackinnon, Andrew, Anthony F. Jorm, Helen Christensen, Ailsa E. Korten, Patricia A. Jacomb, and Bryan Rodgers, "A short form of the Positive and Negative Affect Schedule: evaluation of factorial validity and invariance across demographic variables in a community sample," Personality and Individual Differences, 27 (1999), 405-416.

Mayer, Christopher, Karen Pence, and Shane M. Sherlund, "The Rise in Mortgage Defaults," Journal of Economic Perspectives, 23 (2009), 27-50.

McClure, Samuel M., David I. Laibson, George Loewenstein, and Jonathan D. Cohen, "Separate Neural Systems Value Immediate and Delayed Monetary Rewards," Science, 306 (2004), 503-507.

McClure, Samuel M., Keith M. Ericson, David I. Laibson, George Loewenstein, and Jonathan D. Cohen, "Time Discounting for Primary Rewards," The Journal of Neuroscience, 27 (2007), 5796-5804.

McFadden, Daniel and Gregory Leonard, Issues in the Contingent Valuation of Environmental Goods: Methodologies for Data Collection and Analysis (Amsterdam: North-Holland,

1993).Meier, Stephan, and Charles Sprenger, "Present-Biased Preferences and Credit Card Borrowing," American Economic Journal: Applied Economics, 2 (2010), 193-210.

Meier, Stephan, and Charles D. Sprenger, "Time Discounting Predicts Creditworthiness," Psychological Science, (2011).

Mian, Atif, and Amir Sufi, "The Consequences of Mortgage Credit Expansion: Evidence from the US Mortgage Default Crisis," Quarterly Journal of Economics, 124 (2009), 1449-1496.

O'Donoghue, Ted, and Matthew Rabin, "Choice and Procrastination," Quarterly Journal of Economics, 116 (2001), 121-160.

Paserman, M. Daniele, "Job Search and Hyperbolic Discounting: Structural Estimation and Policy Evaluation*," The Economic Journal, 118 (2008), 1418-1452.

Phelps, E.S. and R.A. Pollak, "On Second-Best National Saving and Game-Equilibrium Growth," Review of Economic Studies, 35 (1968), 185-199.

Preacher, Kristopher J., and Andrew F. Hayes, "Asymptotic and Resampling Strategies for Assessing and Comapring Indirect Effects in Multiple Mediator Models," Behavior research methods, 40 (2008), 879-891.

Prelec, Drazen, "The Probability Weighting Function," Econometrica, 66 (1998), 497-527.

Prelec, D. and G. Loewenstein, "Beyond Time Discounting," Marketing Letters, 8, (1997), 97-108.

Prelec, D., and G. Loewenstein, "The Red and the Black: Mental Accounting of Savings and Debt," Marketing Science, 17 (1998), 4-28.

Read, Daniel, George Loewenstein, and Matthew Rabin, "Choice Bracketing," Journal of Risk and Uncertainty, 19 (1999), 171-197.

Reimers, Stian, Elizabeth A. Maylor, Neil Stewart, and Nick Chater, "Associations Between a One-Shot Delay Discounting Measure and Age, Income, Education and Real-World Impulsive Behavior," Personality and Individual Differences, 47 (2009), 973-978.

RHReward.com, “How Do RH Rewards Work?” (http://www.rhreward.com/howworks) Loan Value Group LLC, (2010).

Samuelson, Paul, “A Note on Measurement of Utility,” Review of Economic Studies, 4, (1937), 155-161.

Slovic, Paul, "Psychological Study of Human Judgment: Implications for Investment Decision-Making," Journal of Finance, 27 (1972), 779-799.

Spiller, Stephen A., Gavan J. Fitzsimons, John G. Lynch, Jr., and Gary H. McClelland, “Spotlights, Floodlights, and the Magic Number Zero: Simple Effects Tests in Moderated Regression,” Journal of Marketing Research, (2013), forthcoming.

Tanaka, Tomomi, Colin F. Camerer, and Quang Nguyen, "Risk and Time Preferences: Experimenal and Household Data from Vietnam.," American Economic Review, (2010).

Thaler, Richard H., “Mental Accounting and Consumer Choice,” Marketing Science, 4 (1985), 199-214.

Thaler, Richard H., "Mental Accounting Matters," Journal of Behavioral Decision Making, 12 (1999), 183-206.

Thaler, Richard H., and Eric J. Johnson, "Gambling with the House Money and Trying to Break Even: The Effects of Prior Outcomes on Risky Choice," Management Science, 36 (1990), 643-660.

Toubia, Olivier, Eric J. Johnson, Theodoros Evgeniou, and Philippe Delquié, " Dynamic Experiments for Estimating Preferences: An Adaptive Method of Eliciting Time and Risk Parameters," Management Science, in press (2012).

Trope, Y., and N. Liberman, "Construal-level theory of psychological distance," Psychological Review, 117 (2010), 440.

Tukey, John W. Exploratory Data Analysis, Reading, MA: Addison-Wesley, (1977).

Tversky, Amos, and Daniel Kahneman, "Loss Aversion in Riskless Choice: A Reference-Dependent Model," The Quarterly Journal of Economics, 106 (1991), 1039-1061.

Tversky, Amos, and Daniel Kahneman, "Advances in Prospect-Theory - Cumulative Representation of Uncertainty," Journal of Risk and Uncertainty, 5 (1992), 297-323.

Tversky, A., S. Sattath, and P. Slovic, "Contingent Weighting in Judgment and Choice," Psychological Review, 95 (1988), 371-384.

Vallacher, Robin R., and Daniel M. Wegner, "Levels of personal agency: Individual variation in action identification," Journal of Personality and Social Psychology, 57 (1989), 660-671.

Weber, Elke U., Eric J. Johnson, Kerry. F. Milch, Hannah Chang, Jeff C. Brodscholl, and Daniel G. Goldstein, "Asymmetric Discounting in Intertemporal Choice," Psychological Science, 18 (2007), 516-523.

White, Brent T., "Underwater and Not Walking Away: Shame, Fear and the Social Management of the Housing Crisis," SSRN eLibrary, (2010).

Wu, G., and A. B. Markle, "An Empirical Test of Gain-Loss Separability in Prospect Theory," Management Science, 54 (2008), 1322-1335.

Zauberman, Gal, "The Intertemporal Dynamics of Consumer Lock-In," Journal of Consumer Research, 30 (2003), 405-419.

Zellner, Arnold, and H Theil, "Three Stage Least Squares: Simultaneous Estimation of Simultaneous Equations," Econometrica, 29 (1962), 54-78.

Zhao, Xinshu , John G Lynch Jr, and Qimei Chen, "Reconsidering Baron and Kenny: Myths and Truths about Mediation Analysis," Journal of Consumer Research, 37 (2010), 197-206.

Zillow.com, "Zillow Negative Equity Report: June 2012 (Q2)," (2012) [http://zillow.mediaroom.com/file.php/1478/Zillow+Neg+Equity+Report_Q2+UPDATED.pdf], Accessed on 10/20/2012.

6. Appendices

Appendix I-A. A Simple Model Motivating Predictions About Time Preferences and Mortgage Choices

Time Preferences and Underwater Mortgages

Consider a simple discrete 3-period model in which a prospective homeowner (agent) with quasihyperbolic time preferences characterized by present bias (low β) and exponential discounting (low δ), where β , $\delta \in (0,1)$, is deciding between two mortgages that are each repaid over two time periods beyond the present (Period 0). The agent can choose to make a larger payment in the present (a "front-loaded mortgage") or during Period 1 and Period 2 (a "back-loaded mortgage"). Following Campbell and Cocco (2003), it is assumed that future consumption events are separable in utility, and assume no ex post inflation uncertainty and risk neutrality. The model concerns only consumers who are naïve to the consequences of their time preferences. Their preferences for each option can be with the following utility functions:

(I-A1a) $$U(Front\ Loaded\ Mortgage) = -P_f - \beta\delta f - \beta\delta^2 f$$

(I-A1b) $$U(Back\ Loaded\ Mortgage) = -P_b - \beta\delta b - \beta\delta^2 b$$

Here P_f and P_b are the initial costs of the two mortgages and f and b reflect their periodic payments, with P_f, P_b, f, $b \in [0,\infty)$. Since, by definition the front-loaded mortgage has a larger initial payment than the latter, $P_f > P_b$. Importantly, this leaves a greater loan balance for the back-loaded mortgage. Since this must be repaid, $b > f$.[31] This setup can be thought of as capturing the decision to put more money down or to pay a larger monthly mortgage payment,

[31] Back-loaded repayment would be even more costly (relative to front-loaded repayment) if the lender faces a nonzero cost of capital.

analogous to the choice between a standard 30-year mortgage and a 2/28 loan. While this model illustrates how time preferences motivate mortgage choices with two periods beyond the present, the logic holds when homeowners pay f and b over any number of periods.

The agent will choose the front-loaded mortgage if U(Front) ≥U(back). This suggests the boundary $P_f{}^*$ such that, as shown in the below diagram, the agent would select the front-loaded mortgage for all values if $P_f < P_f{}^*$and the back-loaded mortgage if $P_f > P_f{}^*$. In other words, higher $P_f{}^*$ values correspond with a greater willingness to pay for front-loaded mortgages instead of back-loaded mortgages.

P_b $P_f{}^*$ ∞

|----------|----------) P_f

{Pick Front} {Pick Back}

Accordingly, by combining equation I-A1a and I-A1b for when $U(Front) = U(Back)$ and rearranging:

(I-A2) $$P_f{}^* = P_b + \beta\delta(b - f) + \beta\delta^2(b - f)$$

Recall that the present research is interested in understanding how willingness to pay for up-front mortgages changes based on time preferences. This relationship can be understood by taking the partial derivatives of $P_f{}^*$relative to β and δ.

(I-A3a) $$\frac{\partial P_f{}^*}{\partial \beta} = (\delta + \delta^2)(b - f)$$

(I-A3b) $$\frac{\partial P_f{}^*}{\partial \delta} = (\beta + 2\beta\delta)(b - f)$$

Equation I-A3 states that as $b > f$, agents are more willing to purchase back-loaded mortgages (i.e. higher P_f*) when they are present-biased (i.e. lower β) and if they exponentially discount the future more (i.e. lower δ). Hence, this model predicts Hypothesis I-1.

Hypothesis I-1: *Present-biased and exponentially discounting agents (low* β and δ*) select more mortgages that enable them to delay payments than patient agents.* For example, agents with $\beta < 1$ or $\delta < 1$ will back-load mortgages more willingly than agents with $\beta = \delta \approx 1$.

Time Preferences and Negative Home Equity

A homeowner is underwater if his or her total debts exceed the market value of the home. Hence a homeowner can become underwater either having more debt or having a lower home market value. As home values fall, homeowners who selected a back-loaded mortgage become underwater before homeowners with otherwise equivalent homes carrying front-loaded mortgages. More formally, suppose the subsequent home's market value, $M \in [0,\infty)$, is discovered only after the down payment is made. At this time, a homeowner with the front-loaded mortgage will owe $2f$ in mortgage debt, while the one with a back-loaded mortgage will owe 2b. As $b > f$, the homeowner with the back-loaded mortgage will owe more in mortgage debt than the homeowner with the front-loaded mortgage. If $2f > M$, the front-loaded mortgage holder is underwater. Since the back-loaded mortgage holder owes more, the back-loaded mortgage holder must also be underwater. In contrast, if $2b > M$, while the back-loaded mortgage holder is underwater, one cannot conclude that the front-loaded mortgage holder is underwater as there exists an $f < b$ such that $2f < M < 2b$. In other words, an underwater back-loaded mortgage is a necessary, but not sufficient, condition for the front-loaded mortgage to be underwater. Critically, as more impatient homeowners are in back-loaded mortgages, more impatient homeowners will get underwater before front-loaded mortgages. The intuition is that impatient homeowners repay their mortgages more slowly, so housing market shocks cause these

homeowners to become underwater before those with less remaining debt. This leads to Hypothesis I-2.

Hypothesis I-2: *The mortgages selected by impatient agents (low* β and δ*) are more likely to become underwater following negative housing market shocks because back-loaded mortgages are repaid more slowly than front-loaded mortgages.*

To summarize, time preferences make predictions of the antecedents of being underwater: present-biased individuals may be more likely to buy a more expensive house given the same financial resources, to put less money down, to refinance the house, and to obtain a mortgage that has minimal upfront payments, such as a balloon or adjustable mortgage. All these decisions are consistent with the notion of accelerating immediate gains by increasing delayed losses and can contribute to negative home equity.

Time Preferences and Strategic Default

The analyses above also apply to the strategic default decision. However, walking away produces one major difference in the structure of the decision. The initial loss in mortgage choice consists of economic costs such as the down payment, brokers' fees, points, and non-economic costs, such as moving, which are offset by relocation into a new house. In contrast, if one were to abandon a mortgage, most of the costs (particularly the non-economic costs) are immediate and without an accompanying immediate gain. Immediate monetary costs and immediate non-monetary costs of finding a rental unit, moving, potential changes of schools and loss of neighbors must offset longer-term savings such as decreased rent relative to the mortgage

payment. Additional costs include social stigma or moral concerns (see Foote, Gerardi and Willen 2008 for a discussion of stigma and an economic model of strategic default). Individuals with more present bias are expected to overweight these costs and be *less* likely to walk away. Thus present-biased individuals may face a form of economic double jeopardy: They are more likely to arrange a riskier mortgage, and are less likely to walk away from the consequences. In contrast, the delayed consequences of mortgage abandonment pit a near-term unattractive option (i.e., continued payment with no buildup of equity) with the longer-term benefits of potentially having positive equity and paying off the mortgage. The impact of individual differences in discounting will again depend on the structure of the long-term costs and benefits.

The contrasting predictions of present bias and impatience for strategic default can be illustrated using a similar analysis. Consider a homeowner with quasihyperbolic time preferences who decides whether to move or walk away. This homeowner values staying in her home and continuing to make mortgage payments (m) as described by the following utility function:

(I-A4) $$U(stay) = -m - \beta\delta m + \beta\delta^2 M$$

Here m is the mortgage payment, M is the expected residual home value after mortgage payments are complete, and β and δ again reflect time preferences. These four values are all assumed to be positive, finite values, and it is assumed that borrowing against future home equity is not available. Similarly, walking away is given by the following utility function:

(I-A5) $$U(walk) = -s - r - \beta\delta r + \beta\delta^2 * 0$$

Where r is the periodic rent payment, s is the short-term cost of moving including both physical costs associated with changing residences and social stigma of defaulting. The homeowner will walk away if $U(walk) \geq U(stay)$ and stay if $U(stay) \geq U(walk)$ and hence there is a

residual home value *M** whereby the homeowner is indifferent between moving and staying. High values of *M** correspond with greater willingness to *walk*, since there is a smaller range of residual home values where the homeowner finds it worthwhile to continue to pay the mortgage. In other words, a higher *M** results in more strategic defaulting.

More specifically, *M** can be characterized by combining equations I-A4 and I-A5.

(I-A6) $$M^* = \frac{m-s-r}{\beta\delta^2} + \frac{m-r}{\delta}$$

Taking partial derivatives shows that changes in time preferences, β and δ, influence the threshold value M* and hence, willingness to walk away.

(I-A7) $$\frac{\partial M^*}{\partial \beta} = \frac{-m+s+r}{\beta^2\delta^2}$$

$$\frac{\partial M^*}{\partial \delta} = \frac{-2*(m-s-r)}{\beta\delta^3} - \frac{m-r}{\delta^2}$$

More present-unbiased people (i.e. higher β) are more willing to walk away (higher *M**) if $\frac{\partial \mathrm{M}^*}{\partial \beta} > 0$. This occurs if $s + r > m$. In other words, more present-biased people are more willing to stay in an underwater home if the present-term costs associated with moving (including rent) exceed the periodic mortgage cost. More impatient people (i.e. lower δ) are more willing to walk (higher M*) if $\frac{\partial M^*}{\partial \delta} < 0$. This occurs if $\beta\delta > 2(\frac{s}{m-r} - 1)$. Hence there exists a range of time preferences where one observes a "*β-δ* reversal" if equation I-A8 holds:

(I-A8) $$\frac{s}{1+\frac{\beta\delta}{2}} < m - r < s.$$

In other words, present bias and exponential discounting have opposite relationships with walking away provided that the periodic savings from walking away (*m-r*) meets two conditions. First, present-biased homeowners are more likely to stay if the net present savings are positive, namely, if the short-term costs of moving exceed the periodic walkaway savings (i.e. *m-r*<*s*).

On the other hand, homeowners who exponentially discount more are more likely to walk away if the periodic default savings exceeds a fraction of the short-term cost of moving (i.e. $\frac{s}{1+\frac{\beta\delta}{2}} < m - r$). While the lower bound on periodic walkaway savings increases with both present bias and exponential discounting, both of conditions are met by range of periodic walkaway savings unless $\beta = \delta = 0$. This leads to the final hypothesis.

Hypothesis I-3: *Homeowners who exponentially discount the future more (low δ) are more likely to default while present-biased homeowners (low β) are less likely to default.*

This analysis suggests that individual differences in time preferences can play a role in mortgage choice and abandonment, but there are clearly other factors that can contribute to the overall understanding. This is important; both because other factors can add to the ability to predict, and to the extent that they covary with time preferences, could be alternative explanations.

Appendix I-B. Descriptive Statistics from Survey of Mortgaged Homeowners

Table I-A1. Variable Descriptions from Survey of Mortgaged Homeowners

Variable	Description	Source	Level	Mean	St. Dev.
(DV) Underwater	Self-assessment of home equity status. Ranges from -2 to 2; 2 is most underwater. Average of two measures.	Prequal. and Main survey.	Individual	0.14	1.42
(DV) Walk-Away Value	Minimum (negative) amount home would need to change in value for mortgage abandonment. Increases with willingness to walk. Calculated based on adaptive estimation.	Main Survey; Calculated	Individual	-141,292	135,622
β	Percent of value retained when a payment is not received today. Decreases with present bias, ranges between zero and 1.	Main Survey; Calculated	Individual	0.88	0.15
δ	Percent of value retained when a payment is delayed for one year. Decreases as exponential discounting increases, ranges between zero and 1.	Main Survey; Calculated	Individual	0.43	0.27
λ	Loss aversion	Main Survey; Calculated	Individual	2.26	1.06
α	Probability Distortion	Main Survey; Calculated	Individual	0.74	0.29
σ	Diminishing Sensitivity	Main Survey; Calculated	Individual	0.64	0.28
Age	Respondent age	Main Survey	Individual	39.8	10.8
Gender	1=Male	Main Survey	Individual	0.34	0.47
Married	1= Married	Main Survey	Individual	0.82	0.38
Income	Yearly household income	Main Survey	Individual	95,539	56,007
Race	1=Caucasian	Main Survey	Individual	0.82	0.39

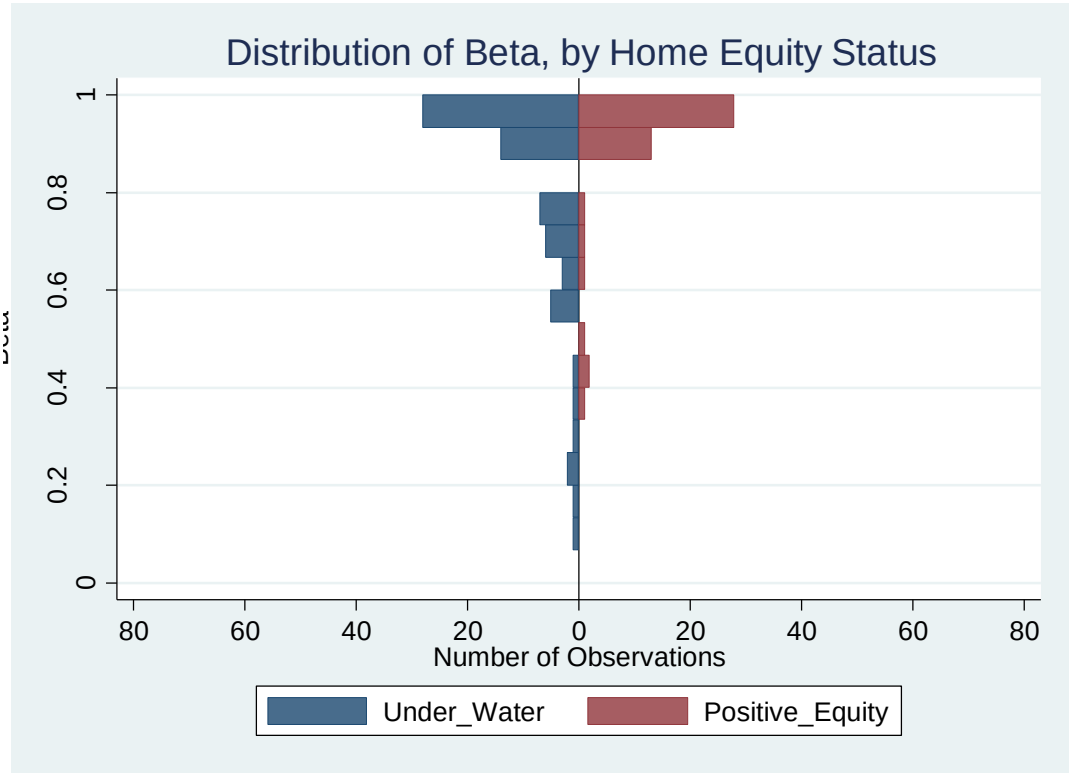
Has Bachelor's Degree	1= Yes	Main Survey	Individual	0.67	0.47
Has Graduate Degree	1= Yes	Main Survey	Individual	0.27	0.45
Employment Security	-2 to 2; 2 is most secure	Main Survey	Individual	0.89	1.17
Debt Literacy & Financial Competency	Combination of financial competency self-assessment and performance on debt literacy items (ranges 0 to near 1).	Main Survey	Individual	0.39	0.22
CRT	Number of Cognitive Reflection Task items correct (out of 3).	Main Survey	Individual	1.14	1.08
Morality Scale	Degree to which respondent views mortgage default in moral terms, from 6 scale items. Ranges from -1 to 1.	Main Survey	Individual	0.29	0.35
Social Connection to Strategic Defaulters	Degree of social connection to strategic defaulters. Ranges from 0 to 1, 1 is closest.	Main Survey	Individual	0.21	0.24
Initial Home Cost	Purchase price of home	Main Survey	Individual	315,246	376,536
Initial Mortgage Size	Amount initially borrowed on home	Main Survey	Individual	286,906	463,218
Adjustable Rate	1 = Mortgage has adjustible interest rate; 0= Mortgage has fixed interest rate	Main Survey	Individual	0.18	0.39
Has Second Mortgage	1 = second mortgage, 0 = no second mortgage	Main Survey	Individual	0.34	0.47
Years in Home	Years since home purchase.	Main Survey	Individual	7.77	5.55
Monthly Mortgage Payment	Amount paid in mortgage per month.	Main Survey	Individual	1,656	1,446
Share of Income Servicing Mortgage	Monthly mortgage payment * 12 / Income	Main Survey; Calculated	Individual	0.23	0.14
Current Mortgage Debt	Amount currently owed in mortgage debt.	Main Survey	Individual	228,904	227,651

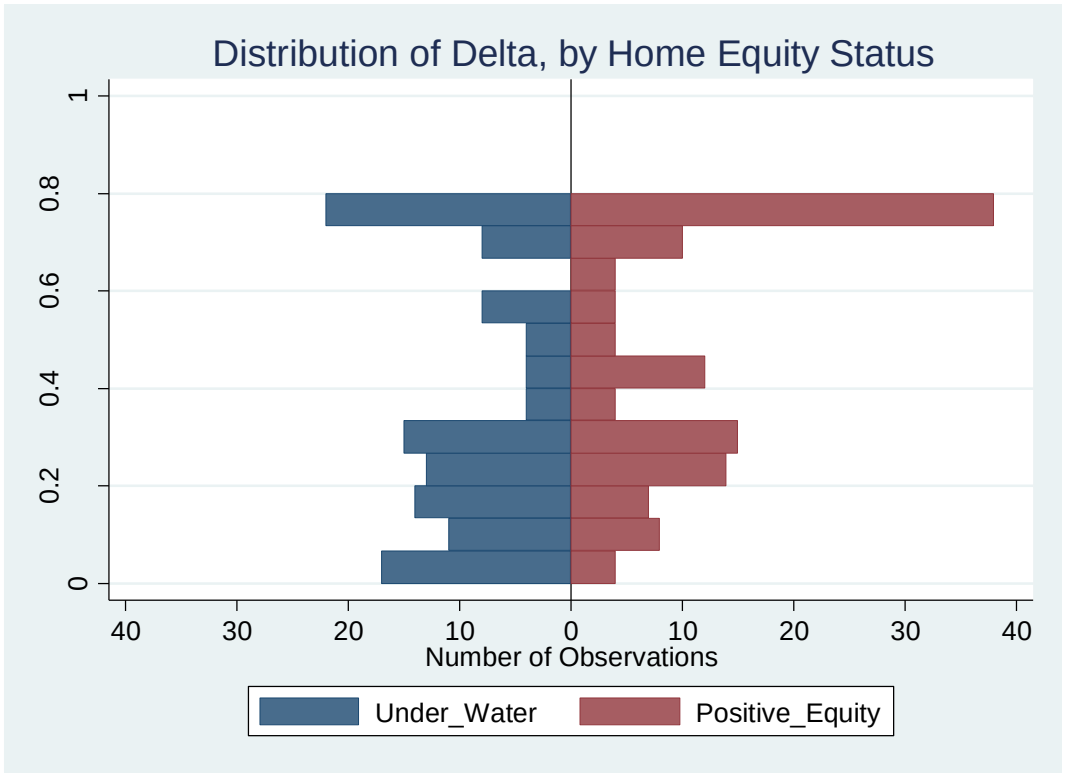
Amount Paid to Date	Monthly payment * Years in Home *12	Main Survey; Calculated	Individual	54,053	201,112
Expectations About Housing Market	Fraction increase or decrease expected in home values over next three years; between -0.35 and 0.35.	Main Survey	Individual	0.00	0.12
Confidence in Housing Market Expectations	Strength of confidence in housing market expectations (-2 to 2; 2 is most confident)	Main Survey	Individual	-0.12	1.18
Avg. Change in Home Price Since Peak, for Zip Code	Percent change in average home prices, ranges from 0.66 to 0.	Zillow	Zip Code	-0.23	0.16
Foreclosures, as Percent of Zip	Homes in foreclosure, as percent of zipcode-level total.	BlackBox	Zip Code	0.41	0.33
Short Sales, as Percent of Zip	Homes in short sale, as percent of zipcode-level total.	BlackBox	Zip Code	0.04	0.04

Table I-A2. Correlation Between Primary Measures of Mortgaged Homeowners

	Under-water	Walking	*Present Bias (1-β)*	*Expon. Disc. (1-δ)*	*Loss Aversion (λ)*	*Dim. Sens. (σ)*	*Prob. Distortion (α)*
Underwater	1.00						
Walking	0.26	1.00					
Present Bias (1-β)	0.28	-0.00	1.00				
Exponential Discounting (1-δ)	0.25	0.15	0.54	1.00			
Loss Aversion (λ)	0.00	0.15	-0.14	-0.16	1.00		
Diminishing Sensitivity (σ)	0.04	0.09	0.17	0.19	-0.58	1.00	
Probability Distortion (α)	0.01	-0.12	0.00	-0.02	-0.20	0.08	1.00

Figure I-A1. Histograms of Intertemporal Preferences, by Home Equity Status





Appendix I-C. Time Preferences, Net Home Equity and Net Worth

Introduction

The first essay in this dissertation explores the relationship between intertemporal preferences and mortgage decisions. It links intertemporal preferences with having negative home equity, mortgage precursors to negative home equity, and the decision about whether to strategically default on the mortgage. The essay proposes that intertemporal preferences are a robust individual differences measure relevant to a wide array of consumer financial decisions and states. This supplement tests the robustness of that claim by testing the relationship between intertemporal preferences and two additional components of a consumer's financial situation, namely, net home equity among homeowners and net worth among all households. Additionally, this supplement aims to provide additional insight into whether other factors qualify the relationship between intertemporal preferences and financial decisions. This section will test a strict time preference account, where intertemporal preferences alone influence net home equity and net worth, and a qualified relationship between intertemporal preferences and financial states that is bounded by the degree of autonomy the consumer has in their choices.

Method

This supplement analyzes market data collected from the representative sample of US households gathered in 2010 by the market research company, Strategic Business Insights (SBI). The analysis will run a series of survey-weighted regressions relating intertemporal preferences, net home equity among homeowners and net worth among both homeowners and nonhomeowners. This relationship will be tested, through the same series of regressions used on this data set, to test the relationship between intertemporal preferences and mortgage precursers,

namely, in turn, (1) without any controls, (2) controlling for loss aversion, (3) controlling for the demographic factors income, marital status, gender, age and education, (4) liquidity constraints (checking, savings account balances and credit card debt, all relative to income) and (5) all controls simultaneously. All continuous varaibles are centered to the relevant population mean, which for net home equity is US homeowners and for net worth is US households. The analysis will then turn to exploring interactions between the controls and intertemporal preferences to assess whether limitations to choices qualify to the general relationship.

If patient intertemporal preferences increase net home equity and net worth, the relationship should be positive and should persist after the controls. If time preferences alone explain these variables, the relationships should not be qualified by factors that restrict choice, but if time preferences explain these variables subject to constraints that consumers face, the relationship between intertemporal preferences and the financial states should weaken when consumer choice is constricted.

Results

To provide context for the results, it is worth noting that homeowners and households have intertemporal discount rates that are dramatically more impatient than those typically assumed by economic models. The average survey-weighted one-year discount rate among homeowners was 0.59 (SD 0.18), and the one-year discount rate among all households was 0.57 (SD 0.18). Homeowners had, on average $111,736 in net home equity (SD 116,424), and households had, on average, $367,549 in net worth (SD 1,016,729).

The data suggests that there is a relationship between intertemporal preferences, net home equity and net worth. First, Table I-A3 summarizes the results from the series of regressions

relating mortgaged homeowners' net home equity with intertemporal preferences (β*δ). The simple relationship is strongly positive (β=85,143 p<0.0001), meaning that a 10% decrease in 1-year discounting (increased patience) corresponds with $8,514 more net home equity. This relationship remains unchanged in magnitude and significance when controlling for loss aversion and liquidity. However, the relationship nearly halves in size and reduces significance somewhat (p<0.01) when accounting for demographics. Among these factors, age, education and income emerge as strongly related to net home equity. As age, education and income increase, net home equity increases.

To provide further insight into how context influences the expression of time preferences, the next set of regressions, summarized in Table I-A4, further investigate whether the relationship between intertemporal preferences and net home equity is qualified by individual differences in loss aversion, demographic factors or liquidity constraints. When predicting net home equity, there is no interaction of intertemporal preferences with loss aversion (Column 1) nor with demographics (Column 2). Intertemporal preferences do, however, interact with credit card debt as a fraction of income (β=-193,849, p<0.05), indicating that with higher liquidity constraints, the relationship between intertemporal preferences and net home equity weakens. This interaction remains marginally significant when controlling for loss aversion and demographics. Floodlight analysis (Spiller, Fitzsimons, Lynch and McClelland, forthcoming) suggests that net home equity increases with patience if credit card debt is less than 23% of income, the maximum credit card debt such that the simple main effect of discounting on net home equity retains a p-value less than 0.05. In other words, time preferences correspond with higher net home equity, provided that participants have sufficient liquidity.

Table I-A5 summarizes the results from the series of regressions relating net worth with intertemporal preferences. The simple relationship is again large and strongly positive (β=1,043,250, p<0.0001), meaning that a 10% increase in patience over one year corresponds with having $104,325 more in net worth. This relationship remains unchanged in magnitude and significance when controlling for loss aversion and liquidity. When accounting for demographics, the relationship diminishes by more than 50%, though it remains strongly statistically significant (p<0.0001). Among these factors, age and income emerge as strongly related to net worth. As age and income increase, net worth increases.

Table I-A6 further explores whether the relationship between intertemporal preferences and net worth is qualified by interaction effects. Notably, across regressions, the relationship between intertemporal preferences and net worth remains consistent for the average household despite the presence of interactions. Yet the results do reveal some interactions between intertemporal preferences and other factors. Column 1 shows that loss aversion does not interact with intertemporal preferences. Column 2 shows that there is an interaction between intertemporal preferences and marital status (p<0.05), as well as with age (p<0.001) and with income (p<0.001), but not with gender nor with education, in predicting net worth. In particular, the relationship between intertemporal preferences weakens for married people relative to unmarried people, and strengthens with age and income. Column 3 shows that these interactions persist in magnitude and significance after dropping the insignificant interactions from the second regression. Column 4 explores interactions between intertemporal preferences and measures of liquidity, finding an interaction between credit card debt as a percentage of income and intertemporal preferences on net worth (p<0.05). This indicates that the relationship between intertemporal preferences and net worth weakens as credit card debt increases relative

to income, which indicates less liquidity. Regression 6 is a combined model including all controls and significant interactions, and the interactions persist, in magnitude and significance, and in fact strengthen for the income-discounting and liquidity-discounting interactions (p's<0.001).

Intertemporal preferences appear to consistently interact with factors restricting the range of choices available to a decision maker to predict net worth. Being married reduces a person's ability to express his or her time individual intertemporal preferences when making choices that will influence the household's net worth. The strengthening of the relationship between intertemporal preferences and net worth by aging can be interpreted as being the legacy effect of stable time preferences previous choices that increase present net worth. Having more income increases autonomy, and the relationship between time preferences and net worth strengthens. When consumers have less liquidity, as operationalized by credit card debt as a fraction of income, the relationship between intertemporal preferences and net worth weakens. Taken together, these results are consistent with a view that consumers make financial choices reflecting their individual differences in intertemporal preferences subject to constraints by things outside their control that prevent their ability to express those preferences (such as having a second person in the household with time preferences of their own, having low income, low liquidity).

Discussion and Conclusions

The evidence from the nationally representative SBI data indicates that, broadly, more patient intertemporal preferences are linked with greater net home equity and net worth. This effect persists after controlling for loss aversion, demographic factors, and liquidity constraints.

However the results further suggest a more nuanced view of the relationship between intertemporal preferences and financial states. Statistically significant interactions between time preferences and marital status, age, income and credit card debt suggest that time preferences are particularly associated with financial states when circumstances enable their time preferences to impact financial choices. In other words, patient preferences increase net home equity and net worth when consumers have the greatest ability to express those preferences in their financial choices.

These findings should be qualified by the observation that the analysis came from a series of regressions, and as such one cannot rule out the possibility of reverse causality (e.g. net worth causes intertemporal preferences) nor that a third factor is driving observed intertemporal preferences as well as financial state. However, taken at face value, the relationships found in this study are support both that patient intertemporal preferences correspond with greater net home equity and net worth and that these preferences are particularly relevant when consumers are able to express those preferences. This result highlights that the introduction of new financial products to the marketplace, such as in the case of the 2-28 mortgage, has the potential to cause overall lifetime welfare harm by enabling consumers to better express impatient intertemporal discount rates. Accordingly, while intertemporal discount rates provide a useful metric to segment and target consumers, marketers and policymakers should not forget that understanding intertemporal preferences also enables them to ensure that new financial products empower consumers overall.

Table I-A3. Net Home Equity, Patience, and Control Variables

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
$\beta^*\delta$ Hybrid (Increases with Patience)	85,143*** (17,887)	85,004*** (18,085)	46,723.9** (17,336)	78,357*** (17,665)	41,840* (17,435)
Loss Aversion (λ)		-149.3 (729.5)			-670 (693)
Married			8,780 (7,119)		8,714 (7120)
Male			-781 (5,928)		-1,643 (5,991)
Age			2,704*** (220)		2,631*** (225)
Has Bachelor's Degree			15,023* (6,347)		13,801* (6330)
Income			0.388*** (0.058)		0.382*** (0.058)
Checking Account Balance to Income				4,365 (8,456)	-1,365 (6,929)
Savings Account Balance to Income				43,156*** (8,891)	25,885*** (7,648)
Credit Card Debt to Income				-35,110** (12,523)	-18,627 (11,746)
Constant	111,850*** (3,131)	111,640*** (3,140)	102,481*** (6,879)	111,966*** (3,094)	103,361*** (6,852)
Adj. R-sq	0.017	0.016	0.169	0.033	0.175
N	2977	2964	2881	2977	2869

Regression coefficients, with standard errors in parentheses.
*** p<0.001; ** p<0.01; * p<0.05; † p<0.10.

Table I-A4. Net Home Equity and Interactions with Patience

	Model 6	**Model 7**	**Model 8**	**Model 9**	**Model 10**
$\beta^*\delta$ Hybrid (Increases with Patience)	84,161*** (18,303)	27,510 (35,300)	75,587*** (17,482)	75,655*** (17,453)	39,707* (17,225)
Loss Aversion (λ)	-193 (728)				-696 (693)
λ * Patience	-2,597 (4,417)				
Married		8,359 (7,131)			8,560 (7,126)
Married * Patience		18,559 (36,918)			
Male		-649 (5,946)			-1,511 (5,990)
Male * Patience		25,390 (33,317)			
Age		2,693*** (220.5)			2,630*** (225)
Age * Patience		1,878 (1,153)			
Has Bachelor's Degree		15,307* (6,310)			13,705* (6,321)
Bachelor's * Patience		-19,475 (34,776)			
Income		0.387*** (0.059)			0.380*** (0.058)
Income * Patience		0.133 (0.284)			
Checking Account Balance to Income			5,732 (8,976)	5,636 (9,201)	-402 (7,512)
Check-to-Inc * Patience			-1663 (42,283)		
Savings Account Balance to Income			41,031*** (8,778)	42,065*** (8,854)	25,028** (7,610)
Savings-to-Inc * Patience			38,194 (44,859)		
Credit Card Debt to Income			-51,631** (17,428)	-52,236** (17,381)	-32,457† (16,798)
CC Debt to Inc * Patience			-193,849* (97,113)	-197,737* (96,910)	-157,230† (94,642)
Constant	111,390*** (3,161)	102,336*** (6,846)	111,435*** (3,084)	111,551*** (3,094)	103,072*** (6,836)
Adj. R-sq	0.016	0.171	0.035	0.035	0.177
N	2964	2881	2977	2977	2869

Regression coefficients, with standard errors in parentheses.
*** p<0.001; ** p<0.01; * p<0.05; † p<0.10.

Table I-A5. Net Worth, Patience, and Control Variables

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
$\beta^*\delta$ Hybrid (Increases with Patience)	1,043,250*** (115,663)	1,036,937*** (117,351)	453,745*** (96,108)	1,004,439*** (115,117)	414,206*** (97191)
Loss Aversion (λ)		-3,259 (3,867)			66 (3,588)
Married			-45,648 (45,972)		-41,004 (46,271)
Male			66,252* (28080)		67,956* (28,010)
Age			14,094*** (977)		13,419*** (975)
Has Bachelor's Degree			47579 (38,074)		47195 (38,195)
Income			6.343*** (0.984)		6.376*** (0.999)
Checking Account Balance to Income				196,543* (77,788)	179,570** (66,163)
Savings Account Balance to Income				184,689*** (46371)	140,915*** (34,840)
Credit Card Debt to Income				-175,293*** (30,919)	-83,134 (62,023)
Constant	374,941*** (15,293)	376,640*** (15,420)	346,283*** (38,105)	375,083*** (15,206)	344,903*** (38,278)
Adj. R-sq	0.031	0.030	0.238	0.041	0.245
N	4,141	4,110	4,007	4,141	3,979

Regression coefficients, with standard errors in parentheses.
*** p<0.001; ** p<0.01; * p<0.05; † p<0.10.

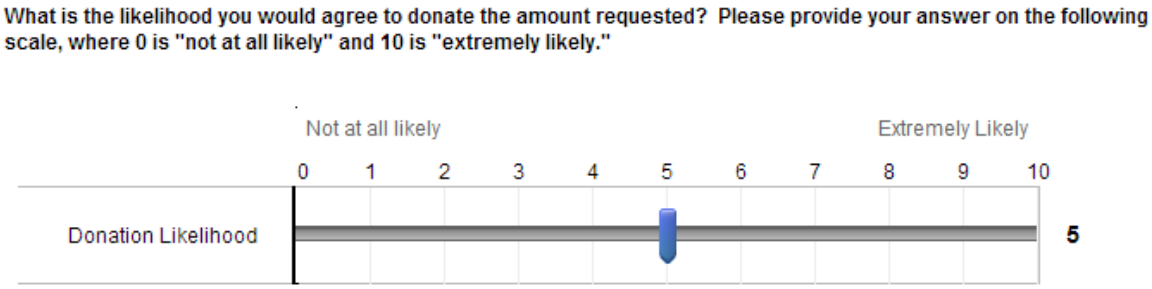
Table I-A6. Net Worth and Interactions with Patience

	Model 6	**Model 7**	**Model 8**	**Model 9**	**Model 10**	**Model 11**
β*δ Hybrid (Increases with Patience)	1,030,139*** (119,028)	845,894** (283,903)	922,515*** (234,128)	1,010,747*** (115,903)	1,009,684*** (115,847)	875,086*** (235,690)
Loss Aversion (λ)	-3,666 (4,143)					-659 (3,323)
λ * Patience	-25,892 (33,691)					
Married		-28,050 (40,578)	-28,035 (40,663)			-21,205 (40,618)
Married * Patience		-647,085* (296,127)	-601,758* (288,887)			-574,955* (288,880
Male		40,335 (26,277)	39,892 (26,013)			44,784† (25,855)
Male * Patience		251,605 (188,118)				
Age		14,062*** (950)	14,104 (955)			13,459*** (946)
Age * Patience		29,236*** (6,905)	30,058*** (6,716)			31,400*** (6,535)
Has Bachelor's Degree		42,214 (35,856)	42,091 (37,216)			36,930 (37,058)
Bachelor's * Patience		-68,938 (231,691)				
Income		5.845*** (0.905)	5.863*** (0.908)			14.38*** (4.291)
Income * Patience		14.51** (4.58)	14.40*** (4.26)			14.38*** (4.29)
Checking Account Balance to Income				210,351** (81,155)	195,119* (77,670)	190,137** (67,866)
Check-to-Inc * Patience				-323,038 (279,074)		
Savings Account Balance to Income				195,235*** (58,238)	184,630*** (46,099)	153,304*** (36,059)
Savings-to-Inc * Patience				-72,102 (232,619)		
Credit Card Debt to Income				-144,993*** (28,652)	-143,506*** (28,440)	-46,547 (43,688)
CC Debt to Inc * Patience				-269,394* (124,320)	-276,750* (127,892)	-386,816*** (108,140)
Constant	374,554*** (15,613)	317,743*** (35,679)	318,342*** (35,564)	376,910*** (15,408)	375,731*** (15,226)	316,059*** (35,548)
Adj. R-sq	0.030	0.267	0.267	0.041	0.041	0.274
N	4110	4007	4007	4141	4141	3979

Regression coefficients, with standard errors in parentheses.
*** p<0.001; ** p<0.01; * p<0.05; † p<0.10.

Appendix II-A. Sample Slider Measuring Willingness to Agree to a Contract

Figure II-A1. Sample Slider Measuring Willingness to Agree to a Contract



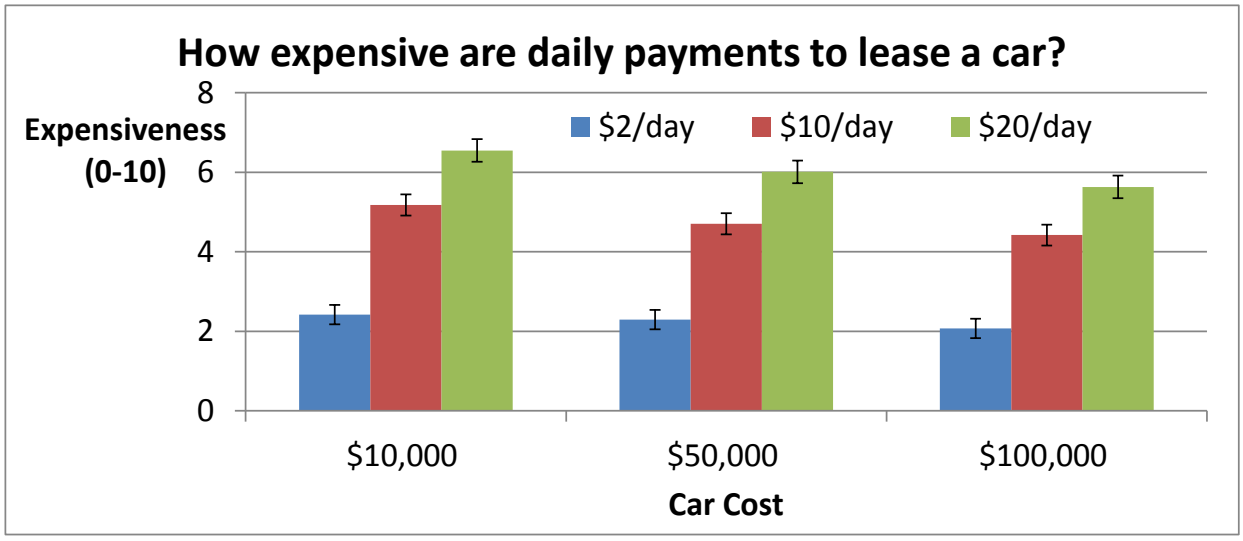
Appendix II-B. Is a $20 Lease Trivial?

One of the key findings from this research is that periodic pricing can work outside the domain of trivial costs. This is seen in Study 2 where individuals are more willing to agree to a hypothetical car lease presented in a periodic pricing frame ($20/day) than the aggregate (yearly) equivalent. As discussed throughout the essay, this essay suggests that these results were observed because the periodic pricing frame changed how an individual perceives the contract's benefits. Yet one plausible alternative account is that the periodic price appears *relatively* trivial, compared to the complete cost while the aggregate cost does not appear relatively trivial. This is an interesting possibility warranting further study not only because it offers a conflicting account from the the present theory but also because, if true, it would suggest other cases where periodic pricing could increase purchase intentions even though it does not call to mind other contracts involving *explicitly* trivial amounts of money**.** Consequently, an ancillary study tested whether consumers consider a car's periodic cost to be trivial when its daily cost is a small fraction of the total base cost of the car, or when the daily cost involves a small number of dollars.

In this study, 95 participants completed a fully randomized 3x3 repeated-measures study. The survey asked participants to suppose they were deciding whether to buy a car, and to rate whether they considered the proposed payment "trivial, like a cup of coffee, or very substantial." The study manipulated the daily cost of the car ($2, $10 or $20) and the base cost of the car ($10,000, $50,000, or $100,000). Each item was presented in the format "Pay $x per day to lease a $y car" and participants responded on a 0-10 scale where 0 was denoted "Very Trivial Expense" and 10 was denoted "Very Substantial Expense." If triviality ratings are relative to the base price of the car, responses would decrease with the cost of the car, whereas if triviality ratings are based on explicit daily amounts, responses would increase with the daily payments.

The results indicate support for both the relative and explicit account of triviality, though there is much stronger support for an explicit account of triviality. As Figure II-A2 illustrates, when base car cost increases by a factor of 10, a repeated measures ANOVA reveals that mean expensiveness ratings decrease from 4.71 to 4.04 ($10,000 vs. $50,000 vs. $100,000 total cost: M_{10k} = 4.71, SD = 3.0 vs. M_{50k} = 4.3, SD = 2.9 vs. M_{100k} = 4.0, SD=2.9; $F(2,188) = 13.4$, $p<0.0001$). As daily payments increase by a factor of 10, mean expensiveness ratings rise ($2 vs. $10 vs. $20 per day: M_2 = 2.3, SD = 2.4 vs. M_{10} = 4.8, SD = 2.6 vs. M_{20} = 6.1, SD=2.8; $F(2,188) = 182.3$, $p<0.0001$). Comparing effect sizes, however, the 10x increase in daily payment amount influenced triviality dramatically more than the 10x increase in base car cost: estimated partial ω^2s reveal that the base car cost accounts for less than 1% of variance while the daily payment amount accounts for 23% of variance. This stark contrast suggests that triviality in periodic pricing is much more influenced by explicit payment amount than how the amount relates to the full cost. These results suggest that the findings in Study 2 are not due to the fact that the periodic price is low relative to the total cost of the car.

Figure II-A2. Daily Payments, Total Costs and Car Lease Expensiveness Ratings



Appendix II-C. Charities Evaluated in Study 3b

Cause 1: Homelessness in America

- "Your company is sponsoring a donation drive to help the underprivileged in the United States."
- "The Cause: The Coalition for the Homeless provides emergency shelter, food and clothing as well as long-term training and housing programs."

Cause 2: Saving the Giant Panda

- "Your company is sponsoring a donation drive to help preserve endangered species of Panda."
- "The Cause: The World Wild Fund for Nature (WWF) works internationally to influence policy-level conservation decisions to protect the Giant Panda's habitat."

Cause 3: Health of Children in Developing Countries

- "Your company is sponsoring a donation drive to improve the lives of impoverished children in developing countries."
- "The Cause: The United Nation's Children's Fund (UNICEF) is a global humanitarian relief organization that promotes the health and well-being of children in developing countries."

Cause 4: American Veterans

- "Your company is sponsoring a donation drive to improve the lives of wounded American veterans."
- "The Cause: The Wounded Warrior Project honors and empowers wounded American veterans by assisting their recovery and transition back to civilian life."

Appendix II-D. Methods of Scale Construction and the Scale Items Used in Study 5.

Scale Construction

Study 5 required constructing scales that would measure numerical ability, construal level, and financial/debt literacy efficiently (i.e., using few items), because of a concern that online participants have a limited ability to provide the attention necessary to give high-quality responses in a long survey. Seventy participants completed the long-form scales in random order, and within each scale the items were randomized.

First, a large numerical ability scale combined 11 items measuring numeracy (Lipkus et al. 2001) and 10 items measuring cognitive reflection (CRT) (Frederick, 2005; Frederick, personal communication, February 29, 2012). The objective was a reliable scale of 4 to 6 items that contained at least two numeracy and two CRT items. Starting with a scale consisting of all 21 items, items were iteratively eliminated based on which had the lowest item-rest correlation, which maximized alpha resulting from the fewest items. The final scale consisted of five items (two numeracy and three CRT) with a Cronbach's α of 0.75. Scores on this scale ranged from zero to one and increased by 0.2 for each item answered correctly.

An analogous process was followed for the construal level scale. Aiming to arrive at a final scale with 4-6 items, items were iteratively dropped, following the procedure described above, from Vallacher and Wegner's (1989) 24-item Behavioral Identification Form to arrive at a four-item scale (α = 0.77). Scores on this scale ranged from zero to one and increased by 0.25 for each abstract option selected.

Finally, a shortened scale comprised items from the 3-item financial literacy (Lusardi and Mitchell 2011) and debt literacy (Lusardi and Tufano 2009) scales. Together, these six items had a Cronbach's α of 0.5335, and again items with low item-rest correlation were iteratively

eliminated. The outcome was a four-item scale (α = 0.5988) that ranged from zero to one and increased by 0.25 for each item answered correctly.

Scale: Numerical ability (correct answers in parentheses)

CRT1. A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost? (5 or 0.05)

CRT2. In a lake, there is a patch of lilypads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? (47)

CRT3. A 21 page album contains 480 photos. Each page displays either 18 large photos or 24 small photos. How many pages display small photos? (17)

NUM1. In the ACME PUBLISHING SWEEPSTAKES, the chance of winning a car is 1 in 1,000. What percent of tickets of ACME PUBLISHING SWEEPSTAKES win a car? (0.1)

NUM2. Suppose you have a close friend who has a lump in her breast and must have a mammogram. Of 100 women like her, 10 of them actually have a malignant tumor and 90 of them do not. Of the 10 women who actually have a tumor, the mammogram indicates correctly that 9 of them have a tumor and indicates incorrectly that 1 of them does not have a tumor. Of the 90 women who do not have a tumor, the mammogram indicates correctly that 81 of them do not have a tumor and indicates incorrectly that 9 of them do have a tumor. The table below

summarizes all of this information. Imagine that your friend tests positive (as if she had a tumor), what is the likelihood that she actually has a tumor? (Please enter a percent.) (50)

	Tested positive	Tested negative	Totals
Actually has a tumor	9	1	10
Does not have a tumor	9	81	90
Totals	18	82	100

Scale: Construal Level / Psychological Distance / Behavioral Identification Form

* denotes concrete (vs abstract) items

Any behavior can be described in many ways. For example, one person might describe a behavior as "writing a paper," while another person might describe the same behavior as "pushing keys on the keyboard." Yet another person might describe it as "expressing thoughts." This form focuses on your personal preferences for how a number of different behaviors should be described. Below you will find several behaviors listed. After each behavior will be two different ways in which the behavior might be identified. For example:

1. Attending class
   a. sitting in a chair
   b. looking at a teacher

Your task is to choose the identification, a or b, that best describes the behavior for you. Simply select the option you prefer. Be sure to respond to every item. Please mark only one alternative for each pair. Remember, mark the description that you personally believe is more appropriate for each pair.

CL1 Making a list

- Getting organized
- Writing things down*

CL2 Voting

- Influencing the election
- Marking a ballot*

CL3 Taking a test

- Answering questions*
- Showing one's knowledge

CL4 Eating

- Getting nutrition
- Chewing and swallowing*

Scale: Financial/Debt Literacy

** denotes correct answers*

Flit1. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy more than, exactly the same as, or less than today with the money in this account?

- More than today
- Exactly the same as today
- Less than today*
- × I don't know

Flit2. True or False? Buying a company stock usually provides a safer return than a stock mutual fund.

- True
- False*
- I don't know

Dlit1. Suppose you owe $1000 on your credit card and the interest rate you are charged is 20% per year compounded annually. If you didn't pay anything off, at this interest rate, how many years would it take for the amount you owe to double?

- 2 years
- Less than 5 years*
- More than 5 years but less than 10 years
- More than 10 years
- Do not know
- Prefer not to answer

Dlit2. You owe $3,000 on your credit card. You pay a minum payment of $30 each month. At an Annual Percentage Rate of 12% (or 1% per month), how many years would it take to eliminate your credit card debt if you made no additional new charges?

- Less than 5 years
- Between 5 and 10 years
- Between 10 and 15 years
- Never, you will continue to be in debt*
- Do not know
- Prefer not to answer