Limited demand for flexibility – commitment, inertia and inattention in debt repayment

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Abstract

The tendency of households to stick to default options in financial decisions is a concern if default options are suboptimal. I study why many households stick to a restrictive default option in debt repayment. A natural experiment provided Finnish households a free option to reduce minimum mortgage amortization (payment of principal) to zero for 1 to 12 months. Only one in five apply for this flexibility, although flexibility dominates the default option of positive minimum amortization. I consider three mechanisms for the limited demand: (i) commitment because of self-control problems, (ii) inertia because of non-pecuniary application costs, and (iii) inattention to the offer. The key reduced-form evidence are that: (a) most attentive households do not apply, (b) most liquidity-constrained households do not apply, (c) many prefer short to maximum flexibility, and (d) consumption drops at the end of flexibility for certain applicants. Because of (a), inattention is an insufficient explanation for limited demand. Both inertia and commitment can explain why some do not apply according to a life-cycle model of optimal debt repayment. But only the commitment model with self-control problems explains (c) and (d). Policymakers should facilitate active choice if inattention and inertia alone explain default effects. By contrast, stickiness of the default option is beneficial if it enables commitment.

Keywords: commitment, inertia, inattention, default options, repayment flexibility
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1 Introduction

Households often stick to the default even if better options seem to exist. Many studies have explained default effects – for instance, in retirement savings, portfolio choice, and mortgage refinancing – by inattention and inertia.[1] A restrictive default option may also serve as a commitment device if self-control problems make choice flexibility harmful. Yet, evidence for commitment is rare in the economy (Laibson, 2015). Reasons for default effects matter, because policymakers should facilitate deviation from the default option to mitigate inattention and inertia. By contrast, deviation from a commitment should be difficult.

This paper uses a natural experiment on debt repayment to study if a desire for commitment reduces demand for flexibility in favor of a restrictive default option. I also consider inattention and inertia as alternative mechanisms for limited demand for flexibility. I use reduced-form evidence on household behavior and a life-cycle model of optimal debt repayment to evaluate if any of the three mechanisms explain limited demand for flexibility in the natural experiment. Commitment and self-control problems can explain behavior inconsistent with only inattention and inertia.

In the natural experiment, mortgage customers of a large Finnish bank received a free flexibility option to reduce minimum amortization (payment of principal) to zero for 1 to 12 months. If a household applied for flexibility, the default monthly amortization was reduced to zero, but the household could make extra amortization payments for free. If a household did not apply, the minimum monthly amortization was strictly positive. Hence, the flexibility offer dominated the default option of positive minimum amortization payments.

Only one in five households apply for flexibility, although flexibility should have significant benefits. First, many mortgage holders are young and expect higher income in the future. Therefore, young households should avoid large debt payments to smooth consumption. Second, flexibility allows impatient households to increase current consumption. Third,

[1]The large literature on default effects in retirement savings and portfolio choice includes Madrian and Shea (2001), Choi et al. (2002), Agnew et al. (2003), Brunnermeier and Nagel (2008), Calvet et al. (2009), Bilias et al. (2010), Alvarez et al. (2012), and Abel et al. (2013). The role of inattention and inertia in slow mortgage refinancing has been documented by Andersen et al. (2015) and Bajo and Barbi (2015).

flexibility has an option value under uncertainty because delaying mortgage payments is cheaper than using credit card debt or other unsecured credit. Similarly, flexibility provides an arbitrage opportunity to repay existing unsecured credit.

I consider three main mechanisms for the limited demand for flexibility. First, inattention can explain limited demand if households are unaware of the offer. Second, households can experience inertia because of a non-pecuniary application cost that reflects the time or psychological cost of application. The application cost can explain non-application if the benefits of flexibility are small. Third, households may commit to positive minimum amortization if self-control problems would lead them to overconsume during flexibility.

To evaluate the three mechanisms, I first document key reduced-form findings. The first finding is that although attention to household finances correlates positively with application, most households who include an employee of the bank responsible for the offer do not apply. Because bank employees must have known about the offer, inattention is an insufficient explanation for limited demand. Second, only a minority of liquidity-constrained households apply, although they have an arbitrage opportunity to reduce unsecured credit. Third, almost half of applicants restrict the amount of flexibility to a shorter period than the maximum. Fourth, applicants who are liquidity constrained before the offer do not smooth consumption at the predictable end of flexibility. Ex-ante constraints do not explain the consumption drop, because a household can smooth consumption at the end by spending less during flexibility.

To understand the key reduced-form findings, I consider three variants of a life-cycle model of optimal debt repayment: (i) a basic model without a non-pecuniary application cost or self-control problems, (ii) an inertia model with a non-pecuniary application cost but no self-control problems, and (iii) a commitment model with self-control problems because of present bias (Laibson, 1997).[2] The basic model predicts that all households would apply for flexibility because flexibility is the dominant option. The inertia model can explain why some households do not apply, but not the preference for short flexibility or the consumption drop at the end of flexibility. The commitment model predicts lower benefits from flexibility than

[2] I do not consider a separate inattention model, because of the first key finding that a minority of (attentive) bank-employee households apply for flexibility. Yet, I discuss the confounder of inattention in model results.

the inertia model. Therefore, the commitment model can explain the observed application rates with a lower non-pecuniary application cost than the pure inertia model without self-control problems. The commitment model also predicts that some households apply for short flexibility; and the model reproduces the observed consumption drop at the end of flexibility for households who are liquidity constrained before the offer. Finally, alternative mechanisms (low financial literacy, intra-household bargaining, application stigma) are unlikely to account for the key reduced-form findings.

Understanding what factors influence debt repayment matters because of a concern that households often make costly mistakes (see for instance Agarwal et al., 2017; Gathergood et al., 2019; Keys et al., 2016). This paper relates in particular to studies on default effects in debt repayment.[3] Default effects can reflect, for instance, anchoring (Keys and Wang, 2016; Navarro-Martinez et al., 2011; Stewart, 2009) or inattention and inertia (Andersen et al., 2015; Bajo and Barbi, 2015). I provide evidence consistent with the hypothesis that households with self-control problems may stick to the default option because it provides commitment. Reasons for default effects matter, because policymakers should facilitate active choice if households stick to a suboptimal default option because of informational frictions such as inattention and inertia. By contrast, policymakers should not undermine restrictive default options that enable commitment for households with self-control problems.

The theory on how self-control problems rationalize commitment is established (see for instance Gul and Pesendorfer, 2001; Laibson, 1997; Strotz, 1955). Yet, evidence for commitment is rare, particularly outside controlled experiments (Laibson, 2015).[4] A notable exception is Cho and Rust (2017), who show that Korean households often choose dominated options by foregoing interest-free installment loans or committing to quick repayment. I similarly find that many households do not apply for payment flexibility, or prefer only short flexibility in a setting with higher stakes.[5] In addition, the natural experiment precludes that households'

[3]Beshears et al. (2018) includes a general review of default effects.

[4]In development economics, multiple experimental papers study commitment and flexibility in credit contracts. Afzal et al. (2019) randomly vary credit contracts of a micro-finance institution and find that flexibility does not increase take up. By contrast, Barboni and Agarwal (2018) document positive demand for flexibility particularly among time-consistent and financially disciplined borrowers.

[5]The average installment loan in Cho and Rust (2017) is around $300, and the maximum interest-free repayment period is 12 months. Therefore, savings from using the interest-free period to pay down other

need for liquidity explains the preference for short flexibility.[6]

Evidence consistent with commitment can also partly explain wealthy-hand-to-mouth (WHtM) households with illiquid wealth but little liquid assets. A household without self-control problems can be WHtM because the long-run benefits from illiquid assets outweigh the short-run costs of low liquid assets (Kaplan and Violante, 2014; Kaplan et al., 2014). Alternatively, a household with self-control problems can be WHtM because the illiquid asset serves as a commitment (Kovacs and Moran, 2019; Laibson et al., 1998; Schlafmann, 2016). WHtM households without self-control problems should value debt-repayment flexibility, because flexibility would alleviate the short-run costs of low liquid assets without sacrificing the long-run benefits from homeownership. My findings are consistent with commitment contributing to the prevalence of WHtM households, because few liquidity-constrained homeowners apply for maximum flexibility.

The next section describes the natural experiment, the data, and the popularity of the offer. Section 3 presents the key reduced-form findings to evaluate the alternative mechanisms for limited demand. Section 4 builds a life-cycle model of optimal debt repayment to understand the reduced-form findings. Section 5 presents model results. Section 6 studies the robustness of the main findings and considers alternative hypotheses for limited demand. Section 7 concludes.

2 Natural experiment of demand for flexibility

This section presents the natural experiment, the data, and how many and what types of households apply for flexibility.

credit or to invest in positive return assets are small. Consequently, the authors note that "transaction and mental accounting costs are the most likely additional or alternative explanation for the behavior we find."

[6] Installment loans count against the credit limit in Cho and Rust (2017). Therefore, households may prefer quick repayment of interest-free installment loans to ensure sufficient liquidity at the point of purchase.

2.1 Description of experiment

In February 2015, a Finnish bank offered its mortgage customers a free flexibility option to reduce minimum mortgage amortization to zero for 1 to 12 months. Households would continue to pay interest during the flexibility period. Households in severe payment difficulties could not apply for the offer, but almost all mortgage customers were eligible. The offer lasted from early February to the end of June 2015.

The offer provided households an unambiguous increase in flexibility. After application, the default amortization decreased to zero. But mortgage holders can make extra amortization payments for free similarly to paying a bill.[7] Therefore, the offer temporarily reduced minimum amortization from a positive amount to zero. Analytically, without flexibility, amortization is $\Delta_t \geq \kappa_t$, where $\kappa_t > 0$ represents the contractual minimum amortization. With flexibility, the amortization choice relaxed to $\Delta_t \geq 0$ for up to 12 months.

The barriers to application were small and the offer was widely advertised. Application was free and took a few minutes to complete online or by contacting the bank. The bank promoted the offer via direct customer contacts and social media. The traditional media also reported on the offer. For instance, the main national newspaper, Helsingin Sanomat, had the flexibility offer as its lead article (February 6, 2015, edition). The term for the policy ("lyhennysvapaa") returns 26 articles published during the application window in Helsingin Sanomat's digital archive.[8] The national broadcasting company Yle also covered the offer.

2.2 Data

Data for this paper come from the bank responsible for the flexibility offer. The bank is among the largest in Finland, with branches across the country. Therefore, the bank's customers are a broad sample of the population. I aggregate nominal variables to the household level because I consider that households make mortgage decisions jointly. In robustness checks

[7] Adjustable-rate mortgages (ARMs) do not penalize extra payments, and ARMs represent 97 percent of mortgages in my data. I omit households with fixed-rate mortgages from the analysis.

[8] https://www.hs.fi/haku/. The search was made on the 20th of March 2019.

(section 6), I discuss the relevance of intra-household strategic behavior for the decision to apply for flexibility.

Demographics and grouping variables: I observe individuals' age, gender, and the number of adults and children in a household. I identify employees of the bank.

Debt: I observe debts at the bank including their purpose (for instance mortgage, unsecured credit), balance, interest rate, and payment schedule. I cannot observe debts at other banks.

Assets: I observe assets at the bank but not outside the bank. I observe a property value estimate equal to the property price at mortgage origination multiplied by a house price index.

Consumption: I observe purchases with debit and credit cards issued by the bank by store category (for instance grocery store, gas station). I use the categorization to create measures of non-durables expenditure as proxies for consumption.

Income: I derive a disposable income measure based on administrative information on taxable labor income in 2015. I observe a second income measure based on monthly flows to bank accounts.

Sample selection

To reduce measurement error, I focus on households who conduct most of their finances at the bank. The bank usually requires new mortgage customers to transfer all finances to the bank. The bank also financially encourages customers to concentrate their finances. To further reduce measurement error, I filter households with the following criteria:

1. No household member states another bank as their main bank.
2. The household receives income payments to their bank accounts in 2014.
3. Household after-tax income is at least 500 EUR/month in 2015.
4. The household has a deposit account with the bank.
5. The household has a credit card issued by the bank.
6. The household makes average monthly card purchases of at least 200 EUR in 2014.
7. The mortgage has a property collateral.
8. I omit entrepreneurs because of uncertainty about business and personal accounts.

9. I omit households with fixed-rate mortgages because they do not allow free extra amortization payments.

I also omit households in severe payment difficulties to ensure eligibility for the offer. After the restrictions, my main sample includes 204,246 households. Table 1 provides descriptive statistics on the key variables for this population.

2.3 How many and what types of households apply for flexibility?

Demand for flexibility is limited but heterogeneous by household characteristics. Out of 204,246 households in my data, 44,292 apply for flexibility, that is, 21.7 percent. Unconditionally, application correlates positively with liquidity constraints proxied by low deposit balances, high unsecured credit balances, and high minimum amortization payments (Table 2). Applicants also have a higher loan-to-value ratio. Liquidity constraints remain among the best application predictors in a linear probability model that measures the marginal impact of household characteristics on application probability (Table 3).

On the other hand, applicants are not particularly poor or (ex-ante) risky. Application propensity does not vary strongly by expenditure or property value, either unconditionally or conditionally. Applicants have lower interest rates than non-applicants. Consequently, the bank did not consider the applicants (ex-ante) particularly risky. The negative connection between application and interest rates is understandable, because a higher interest rate decreases the benefits of flexibility.

The connection of age and income to application needs care. Unconditionally, applicants are younger than non-applicants (Table 2). Yet, the marginal predictive power of age is low after controlling for differences in other characteristics (Table 3). Conversely, disposable income is similar in the two groups, although the marginal impact of extra income is negative. But disposable income is the only variable partly determined after the February 2015 offer, because the variable measures income for the calendar year 2015. Therefore, the negative correlation can reflect reverse causality if households worked less after application. Unfortunately, I lack administrative income data for 2014. If I replace the administrative income measure with income flows to the bank account in the six months *before* the offer announcement, income does not have a marginal effect on application. The conflicting results can reflect reverse causality or measurement error in the bank-based income measure.

3 Key reduced-form findings

This section details key reduced-form findings to evaluate different explanations for limited demand for flexibility. The key findings are that: (i) a minority of attentive households apply for flexibility, (ii) a minority of liquidity-constrained households apply for flexibility, (iii) almost half of applicants restrict the length of flexibility to a shorter period than the maximum, and (iv) consumption drops at the end of the flexibility period for applicants who are liquidity constrained before the offer.

Finding 1: A minority of attentive households apply for flexibility

The simplest explanation for why households do not apply for flexibility is unawareness about the offer. To evaluate whether inattention is sufficient to explain non-application, I isolate a subset of mortgage holders who must have known about the offer: households who included an employee of the bank responsible for the offer (N = 7,439). Only 34 percent of bank-employee households with a mortgage apply. Consequently, inattention is an insufficient explanation for limited demand for flexibility.

Inattention can still contribute to the low application rate even if inattention is an insufficient explanation. Therefore, I study the link between general attention to household finances and application with two attention proxies. The first proxy is the number of logins to online or mobile banking, which has been used previously in the literature (see for instance Jørring, 2018; Olafsson and Pagel, 2017). The login data unfortunately exist only from 2017 after the flexibility policies had ended. Consequently, a connection between logins and application can reflect reverse causality if application for flexibility increases attention to household finances. Therefore, I use the share of messages sent by the bank opened by the customer in online or mobile banking as a second attention proxy. The message data are from 2014, the year before the offer announcement.

Both attention proxies correlate positively with application in a linear probability model when controlling for other household characteristics (Table 4). A household in the top quartile by online logins is 8 percentage points (35 percent of the mean probability) more likely to apply than a household in the bottom quartile. A household who read all online messages sent by the bank in 2014 is 4 percentage points (20 percent of the mean probability) more likely to apply than a household who read no messages. Both specifications control for household characteristics present in the baseline linear probability model without attention proxies (Table 3).[9] In addition, the regression based on online messages controls for the total number of messages. Limited use of online banking is not a concern for the representativeness of the results, because over 98 percent of households received at least one online message in 2014 and logged in at least once to online or mobile banking in 2017.

Finding 2: Most liquidity-constrained households do not apply

Small potential benefits could explain why many households do not apply for flexibility. Application correlates positively with characteristics that increase the benefits of flexibility (Tables 2 and 3). This correlation is consistent with some households sticking to the default amortization schedule because a non-pecuniary application cost outweighs the modest benefits of flexibility.

Nevertheless, only 38 percent of liquidity-constrained households apply for flexibility, although the potential benefits are large. For these households, flexibility allows to replace expensive unsecured credit with cheap mortgage debt. I define a household as liquidity constrained if net liquid assets are negative at the end of the month.[10] According to my definition, 20 percent of households with a mortgage are liquidity constrained before the offer in January

[9] The controls include: the average age of adults in the household, the number of adults and children, the municipality, deposits, unsecured credit, credit card utilization, disposable income, card purchases, amortization and mortgage size, property value, mortgage age, and for whether the household includes a bank employee.

[10] Net liquid assets equal the sum of deposit balances, mutual fund holdings and stock holdings minus interest-paying unsecured credit.

2015. The size of the group is similar to the share of wealthy-hand-to-mouth households with illiquid wealth but little or no liquid assets in a cross-section of advanced economies (Kaplan et al., 2014).[11] In my sample, 91 percent of liquidity-constrained households are wealthy-hand-to-mouth because they have positive net housing equity.

Transitory liquidity constraints or inattention do not explain the low application rate among liquidity-constrained households. 71 percent of liquidity-constrained households who do not apply remain liquidity constrained after 12 months (Figure A.3). Inattention is an insufficient explanation, because only 55 percent of liquidity-constrained (and attentive) bank-employee households (N = 1,195) apply.

The low application rate among liquidity-constrained households is first-stage evidence that many households with large potential benefits do not apply for flexibility. In the next section, I use a life-cycle model of optimal debt repayment to derive a model-based measure for the benefits of flexibility.

Finding 3: Many apply for short flexibility policies

The distribution of flexibility policy lengths among applicants reveals whether households restrict the amount of debt-repayment flexibility. The two default lengths for flexibility were 6 and 12 months, but a household could choose an idiosyncratic length shorter than 12 months.

Many households choose a flexibility period shorter than the maximum (12 months). Conditional on application, 24 percent choose 6 months and 21 percent choose a length other than 6 but shorter than 12 months (Figure 1). These households know about the offer, choose to pay any non-pecuniary application cost, and yet forego maximum flexibility.

Maximum flexibility dominates the option of short flexibility because applying for maximum flexibility does not prevent extra amortization payments. Therefore, a fixed application cost cannot by itself explain the preference for short flexibility policies. In the next section, I use a life-cycle model to study if self-control problems can rationalize the preference for short

[11] In Kaplan et al. (2014), the share of wealthy-hand-to-mouth households is typically around 20 percent of all households, but their sample does not include Finland. I only study households with a mortgage.

flexibility.

Finding 4: Consumption drops at the end of flexibility for constrained applicants

Consumption behavior around the flexibility period relates to how households discount utility intertemporally. I focus on whether households smooth consumption at the end of flexibility when the resumption of positive minimum amortization payments causes a predictable decrease in discretionary disposable income.

I study consumption at the end of flexibility with an event-study regression, in which I compare the consumption change for applicants with non-applicants. Non-applicants are a valid control group under the assumption that the end of flexibility is the only major change with heterogeneous impacts on the consumption of applicants and non-applicants during the event window. In robustness checks (section 6), I re-estimate the event-study regression with a matched-on-observables sample of non-applicants as controls.

The event study regression is:

$$\begin{aligned} y_{i,c,t,p} = \alpha_i + \lambda_t + \mathbf{1}_{c=apply} \sum_{p=e-3}^{e+5} \delta_p \mathbf{1}_{period=p} + \\ \delta_{early} \mathbf{1}_{c=apply} \mathbf{1}_{period<e-3} + \delta_{late} \mathbf{1}_{c=apply} \mathbf{1}_{period>e+5} + \epsilon_{i,c,t,p} \end{aligned} \tag{1}$$

, where y is logged consumption, c refers to the cohort (apply, do not apply), α_i are household fixed effects, and λ_t are common time effects. The symbol e refers to the last month of the flexibility policy, which is the baseline month (period dummy omitted from the regression). The period dummies interacted with the application dummy capture the consumption evolution for applicants relative to non-applicants around the end of flexibility. I estimate the equation separately for applicants who are liquidity constrained before the offer and for applicants unconstrained before the offer.

Applicants who are liquidity constrained before the offer reduce consumption by approximately 5–6 percent two months after the flexibility policy ends compared with the last month with zero minimum amortization (Figure 2 and Table 5). Conversely, unconstrained applicants smooth consumption at the end of flexibility. The results do not depend on the consumption measure: total non-durables expenditure or expenditure on essentials including groceries, energy, public transportation, and gasoline.

Ex-ante constraints do not necessitate the consumption drop at the end of flexibility. Households can smooth consumption at the end by limiting spending even if they cannot access credit. In the next section, I use a life-cycle model of optimal debt repayment to evaluate whether a household with or without self-control problems would smooth consumption at the end of flexibility.

4 Understanding limited demand with a model

This section presents a life-cycle model of optimal debt repayment to evaluate the key reduced-form findings.

4.1 Life-cycle model of optimal debt repayment

The life-cycle model considers optimal amortization and consumption for a household with a given mortgage and net liquid assets. The general model nests the (i) basic model with time-consistent CRRA preferences, (ii) the inertia model with non-pecuniary application costs, and (iii) the commitment model with present-biased preferences (Laibson, 1997). I specify a monthly model to study, for instance, consumption at the end of flexibility. I do not have a separate inattention model, because of the first key finding that most attentive employee households do not apply. Yet, I consider the confounder of inattention when I discuss model results.

Household problem

$$\max_{\{C,\Delta\}} U = \frac{C_t^{1-\rho}}{1-\rho} + \beta\mathbb{E}[\delta\frac{C_{t+1}^{1-\rho}}{1-\rho} + \delta^2\frac{C_{t+2}^{1-\rho}}{1-\rho} + \sum_{j=t+3}^{T}\delta^{j-t}\frac{C_j^{1-\rho}}{1-\rho}] \tag{2}$$

Households maximize discounted lifetime utility by choosing consumption (C) and amortization (Δ). Equation 2 nests both the standard time-consistent model and the present-biased model. In the basic model with no present bias ($\beta = 1$), the household problem collapses to the standard recursive form:

$$V_t(A_t, M_t, P_t) = \max_{C_t, \Delta_t} \frac{C_t^{1-\rho}}{1-\rho} + \delta \mathbb{E}[V_{t+1}(A_{t+1}, M_{t+1}, P_{t+1})] \tag{3}$$

The state variables are net liquid assets (A_t), mortgage (M_t), and permanent income (P_t). The household has a constant relative risk aversion (CRRA) utility function with coefficient of relative risk aversion ρ. The household dies with certainty in period T when the household turns 80 years old.

With present bias ($\beta < 1$), the utility function distinguishes between the discount rate between the current and next period ($\beta\delta$), and the discount rate between consecutive periods in the future (δ). The present-biased household is particularly impatient about immediate consumption but discounts future consecutive periods similarly to the time-consistent household.

Housing

The model studies optimal behavior conditional on owning a given house. I do not consider the decision to buy a different house, become a renter, or take a loan collateralized by housing equity. Consequently, I miss the downsizing of housing toward the end of life, which can underestimate the benefits of flexibility, because the housing equity released by downsizing should increase the motive to consume when young to smooth life-cycle consumption. The simplification of no collateralized borrowing is reasonable because housing equity loans for consumption are uncommon in Finland.[12] Housing equity loans also charge a higher interest rate than mortgage loans. Therefore, housing equity loans do not render the flexibility offer redundant, because the offer is more generous. Finally, if flexibility crowds out collateralized borrowing for durables purchases, I underestimate the benefits of flexibility because I do not model durables purchases/collateralized loans.

[12] Households typically use housing equity loans to finance home renovations or other durables purchases.

Flow budget constraints

$$A_t^e = A_t - \Delta_t - r_{mort,t} M_t - C_t \tag{4}$$

$$A_{t+1} = R_{liq,t} A_t^e + Y_{t+1} \tag{5}$$

$$M_{t+1} = M_t - \Delta_t \tag{6}$$

End-of-period liquid assets (A_t^e) are beginning-of-period liquid assets minus the mandatory mortgage interest payment ($r_{mort,t} M_t$) and the chosen amortization and consumption. The following period's liquid assets (A_{t+1}) are last period's end-of-period assets multiplied by the interest rate on liquid assets plus next period's income realization (Y_{t+1}). Mortgage balance declines between periods by the chosen amortization amount.

The interest rate on the liquid asset is kinked because deposits yield low returns, whereas unsecured borrowing is expensive:

$$R_{liq,t} = \begin{cases} R_{boro,t}, & \text{if } A_t^e < 0 \\ R_{save,t}, & \text{otherwise.} \end{cases} \tag{7}$$

Choice constraints

The household needs to make a minimum amortization payment in each period:

$$\Delta_t \geq \kappa_t \tag{8}$$

Households also face an unsecured borrowing limit:

$$A_t^e \geq \psi_t \tag{9}$$

Income process

Income is subject to transitory idiosyncratic shocks around a predictable hump-shaped life-cycle profile.[13] Permanent income grows by Γ between periods. The transitory income shock (Ω) is a draw from a log-normal distribution with probability $1-p$ and takes a minimum value τ_{Unemp} with probability p (representing for instance unemployment). Realized income is permanent income multiplied by the transitory shock. At 65 years, the household retires and receives as risk-free pension income a fraction of the final labor income:

$$P_{t+1} = \Gamma_{t+1} P_t \tag{10}$$

$$Y_t = \begin{cases} P_t \Omega_t, & \text{if } t < T_{retire} \\ \tau_{\text{Pension}} P_{T_{retire}-1}, & \text{if } t \geq T_{retire} \end{cases} \tag{11}$$

$$\Omega_t = \begin{cases} e^{s_t}, & \text{with probability } 1-p \text{ where } s_t \sim \mathcal{N}(\mu,\, \sigma_\Omega^2) \\ \tau_{\text{Unemp}}, & \text{with probability } p. \end{cases} \tag{12}$$

The model does not include permanent income shocks. Permanent shocks would preclude normalizing the model with permanent income because the minimum amortization payment would change from a parameter to a state variable. The mortgage contract defines the minimum amortization in euros; hence, minimum amortization does not fluctuate with income shocks. In the model calibration, I compensate the omission of permanent shocks with a higher standard deviation for the transitory shocks.

The omission of permanent shocks is not necessarily innocuous, because households are better able to smooth transitory than permanent shocks. Consequently, high transitory shocks and no permanent shocks can overestimate the benefits of flexibility if households strongly value precautionary savings that help mainly against transitory shocks. Therefore, the current

[13] For measuring and modeling earnings risk, see, for instance, Carroll (1992) and Gottschalk et al. (1994). Recently, Kuchler and Pagel (2018) use a model of only transitory shocks around a predictable life-cycle profile to evaluate the role of present bias in credit card debt repayment.

modeling of income risk is a limitation of the model with two mitigating factors: (i) no shocks are truly permanent in a life-cycle model, because, for instance, a permanent and transitory shock in the last period of life are equivalent, and (ii) based on sensitivity checks, the size of transitory income uncertainty does not quantitatively drive the benefits of flexibility.

Flexibility offer in the model

The flexibility offer is an option to choose a looser constraint on the minimum amortization payment for up to 12 months. Under the baseline repayment schedule, minimum amortization is strictly positive if the household has a mortgage: $\mathrm{M_t} > 0 \rightarrow \kappa_t > 0$. If the household applies for flexibility in period t for t_{flex} months, the minimum amortization decreases to 0 temporarily starting from the following month: $\kappa_j = 0, j = [t+1, \ldots, t+t_{\text{flex}}]$. After the flexibility period is over, minimum amortization is the same in both scenarios.

Value of flexibility

I measure the value of flexibility by how much liquid assets the household would give up (η) to be indifferent between flexibility and baseline minimum amortization:

$$V_{t,baseline}(A_t, M_t, P_t) = V_{t,flexibility}(A_t - \eta, M_t, P_t) \tag{13}$$

If $\eta > 0$, the household prefers flexibility to baseline minimum amortization and is willing to give up liquid assets to keep it. If $\eta < 0$, the household prefers the baseline minimum amortization path.

Households can experience a non-pecuniary application cost that reflects the psychological burden or time required to complete the application for flexibility (θ). The benefits of flexibility need to offset the application cost for the household to prefer flexibility ($\eta > \theta$).

4.2 Model variants

Basic model

The basic model considers time-consistent households ($\beta = 1$) without a non-pecuniary application cost ($\theta = 0$). Households in the basic model weakly prefer flexibility because flexibility is the dominant option. Flexibility enlarges the amortization choice to the region $[0, \kappa_t)$ for up to 12 months. Flexibility gives households additional choices but does not preclude any option available under baseline amortization.

Inertia model

The inertia model considers time-consistent households ($\beta = 1$) with a non-pecuniary application cost ($\theta > 0$). The household in the inertia model requires the benefits of flexibility to exceed a threshold to compensate for the application cost: Flexibility $\succ$ Baseline $\Leftrightarrow \eta > \theta$.

Commitment model

The commitment model considers sophisticated present-biased households ($\beta < 1$). Sophisticated households correctly anticipate future present bias: $\hat{\beta}_{\text{sophisticated}} = \beta$, which is a requirement for a present-biased household to value commitment. A naive household would not value commitment, because the naive household would expect that future selves are not present biased: $\hat{\beta}_{\text{naive}} = 1$.

A sophisticated present-biased household may prefer commitment if future selves would overconsume relative to lifetime resources during flexibility. Commitment to positive minimum amortization payments limits maximum consumption during flexibility, which can lead to better consumption smoothing from the perspective of the household who decides whether to apply for flexibility that starts in the next period. Appendix B contains further discussion about present-biased preferences and conditions in which commitment is beneficial for a present-biased household.

The commitment model does not consider a non-pecuniary application cost in the base case, because commitment is an alternative hypothesis for limited demand for flexibility. Yet, I also consider present bias together with a positive non-pecuniary application cost because the two mechanisms are compatible.

4.3 Model calibration

The model calibration consists of two parts. First, most model parameters are common to all model variants, but the two discount-rate parameters (β and δ) differ in variants with or without present bias. Second, certain parameters are specific to each household based on bank microdata. Household-specific parameters generate heterogeneity in the benefits of flexibility and predicted behavior when I solve the life-cycle model for a sample of households.

Parameters in different model variants

Table 6 presents the parameters in the different model variants common to all households. Although I solve the model at the monthly frequency, I present the long-term discount factor, interest rates, and the standard deviation of the transitory income shock as yearly equivalents.

Preference parameters

The only parameters that vary across model variants are the long-term discount factor (δ) and the short-term discount factor (β). In the basic and inertia models, I set the long-term discount factor to $\delta = 0.97$ at the annualized level. I specify a relatively patient value for δ to avoid overestimating the benefits of flexibility. In robustness checks (section 6), I test how varying δ changes the key inertia model predictions. Households in the basic and inertia models are not present biased ($\beta = 1$).

In the commitment model, I set the short-term discount factor to $\beta = 0.7$, a common value in the literature (see for instance Angeletos et al. (2001)). Laibson et al. (2018) estimate β in the range [0.13–0.62] for coefficients of risk aversion between 0.5 and 3.[14] My setup differs from both Angeletos et al. (2001) and Laibson et al. (2018) because their models are yearly, whereas in my model, a period lasts one month. The duration of the period is crucial because if all consumption within the year occurs *in the present*, households with self-control problems would strongly prefer flexibility. Therefore, for commitment to matter, flexibility needs to occur in the future when the household wants future selves to smooth consumption.

[14] The reported β estimates refer to the case of sophistication reported in Appendix Table 6A in Laibson et al. (2018).

The present-bias literature has not converged to a particular duration of present (DellaVigna, 2018; Ericson and Laibson, 2018). Yet, experimental evidence suggests a substantial amount of discounting occurs already in one week (Augenblick, 2018).

I set the long-term discount factor to $\delta = 0.99$ in the commitment model and the coefficient of relative risk aversion to $\rho = 1.5$, consistent with estimates in Laibson et al. (2018).[15] I use the same value for ρ in the basic and inertia models.

Income process parameters

I derive the life-cycle income pattern based on the 2014 equivalized disposable income series by age provided by Statistics Finland (Figure A.4). Because I lack long-term panel data on income, I cannot run a panel estimation taking into account cohort effects. Therefore, I use the differences in disposable income by age to measure permanent income growth. The calibration of permanent income growth by cross-sectional data underestimates expected income growth for young cohorts, because I do not account for aggregate economic growth. Therefore, I underestimate the benefits of flexibility for young households who should consume more when young if they expect higher income growth to smooth life-cycle consumption.

The standard deviation of transitory income shocks (0.2) is twice the value in Carroll (1992) to account for the absence of permanent income shocks. In addition, I set the probability of the minimum income shock to the average unemployment rate during 2000–2014 (8.3 percent).[16] I set the minimum income replacement rate to the typical unemployment benefit level at 60 percent of permanent income.[17] The mean of the transitory income shock is 1. I set the riskless pension income to the average pension replacement rate at 60 percent of final labor income.[18]

Interest rate parameters

The initial real interest rate on positive liquid assets is 1 percent. This value is an upper

[15] These values for δ and ρ are mid-point estimates in the case of sophistication reported in Appendix Table 6A in Laibson et al. (2018). I use a more patient value for β than estimation results in Laibson et al. (2018), because my (monthly) model is at a higher frequency.

[16] http://www.stat.fi/til/tyti/index_en.html

[17] http://www.tyj.fi/eng/earnings-related_allowance/allowance_calculator/

[18] https://www.etk.fi/wp-content/uploads/tyoelakeindikaattorit-2018.pdf

bound for the initial deposit yield because the average nominal rate was 0.22 percent for current account deposits and 1.14 percent for fixed-term deposits in January 2015 according to Bank of Finland data.[19] Inflation in January 2015 was -0.2 percent, which compensated for the low nominal rates. The initial real interest rate on negative liquid assets (7 percent) reflects the typical interest rate charged by the bank for unsecured borrowing.[20] Unsecured borrowing rates are not household specific, because the bank uses quantity restrictions instead of price discrimination in the supply of unsecured credit.

Households expect both nominal interest rates and inflation to rise from the levels in 2015. Most interest rates in Finland are tied to the Euribor reference rates.[21] In January 2015, the 12-month Euribor rate was 0.3 percent. Households expect Euribor rates to stay at 0.3 percent for two years, consistent with the March 2015 Bank of Finland forecast.[22] Afterwards, the Euribor converges over three years to its pre-crisis average over January 1999–August 2008 (3.5 percent).[23] The increase in Euribor transmits one for one to mortgage and unsecured borrowing rates, consistent with terms of the debt contracts. The increase in Euribor transmits by only 0.3 to the liquid asset yield, because the spread between the borrowing and lending rates has historically been procyclical.[24] Expected inflation converges by the end of 2016 to its average over the 2000s (1.8 percent), consistent with private forecasts by the bank and the European Central Bank's target of below but close to 2 percent.

Parameters specific to each household

Table 7 presents the household-specific parameters, which generate heterogeneity in benefits of flexibility and predicted behavior. The model accounts for the household-specific age, income, mortgage balance and interest rate, net liquid assets, unsecured borrowing limit, and

[19] https://www.suomenpankki.fi/en/Statistics/mfi-balance-sheet/tables/rati-taulukot-en/talletusten_ja_lainojen_korot_en/

[20] This rate is a lower bound for the total cost of unsecured borrowing, because the rate excludes non-interest fees.

[21] Interest rates are most commonly tied to 3-month, 6-month or 12-month Euribor rates. I consider a single Euribor rate because from 2000 to 2014, average spreads were 0.16 percent (12M vs. 6M) and 0.27 percent (12M vs. 3M) based on Bank of Finland data.

[22] https://helda.helsinki.fi/bof/bitstream/handle/123456789/13800/eurotalous_315_12.pdf?sequence=1&isAllowed=y

[23] https://www.quandl.com/data/ECB/RTD_M_S0_N_C_EUR1Y_E-Rate-1-year-Euribor-Euro

[24] The estimate of 0.3 is based on regressions of deposit rates on Euribor rates.

minimum amortization. Net liquid assets are the sum of deposits and other financial assets minus unsecured credit. The model also accounts for whether a particular household has a fixed amortization or annuity mortgage.

4.4 Model solution

I solve the model numerically by backward induction. I normalize the model by permanent income to speed up the solution. I solve for optimal consumption and amortization with two-step methods developed by Druedahl (2019). I also build on the Heterogeneous Agents Resources and toolKit (HARK) to solve and simulate the model (Carroll et al., 2018).[25] I describe the solution methods in detail in Appendix A.

4.5 Flexibility in basic model

This section provides intuition, in the basic model without application costs or self-control problems, i) on the behavioral effects of flexibility, and (ii) for why flexibility is beneficial.

Behavioral differences under flexibility and baseline amortization

To provide intuition for the effects of flexibility in the base case of time-consistent households, I solve for optimal behavior for a typical household with a mortgage under both the baseline amortization schedule and flexibility. The example household is 40 years old, with a 4,000 EUR monthly disposable income, a 120,000 EUR mortgage, and 6,000 EUR of liquid assets. The mortgage maturity is 12 years, which yields a 833 EUR minimum amortization per month. The unsecured credit borrowing limit is 6,000 EUR.

I first solve the model in the baseline scenario with always positive minimum amortization. I simulate optimal behavior up to death at 80 years. In the flexibility scenario, I consider an unanticipated information shock after a six-month “pre-period” of positive minimum amortization. The household learns about the flexibility offer that starts in the following month and lasts for 12 months. I solve and simulate optimal behavior during the flexibility

[25]The HARK project can be followed at https://github.com/econ-ark/HARK.

period. After the flexibility period, the choice and value functions are the same in the flexibility and baseline scenarios. But realized choices differ because of different choices during the flexibility period.

Over the life cycle, the main effect of flexibility is that the household consumes more when young and less when old (Figure 3 panel A). The young household finances higher consumption by repaying the mortgage more slowly (panel B). The results represent average behavior over 1,000 simulations with different income shock realizations.

In the short run, flexibility produces a 6 percent increase in consumption (Figure 4). Consumption increases already when the household learns about flexibility starting next month, because the household wants to smooth consumption. The household also smooths consumption over the predictable end of flexibility. To achieve this smoothing, the household uses part of the reduction in amortization payments (Figure 5 panel A) to increase net liquid assets (Figure 5 panel B) during flexibility.

Benefits of flexibility in basic model

How much better off is the household under flexibility? Using the measure of benefits of flexibility defined in equation 13, the benefit for my example household is $\eta_0 = 2{,}052$ EUR. Multiple channels affect the benefits of flexibility: (i) the life-cycle effect, (ii) the impatience effect, (iii) the option effect, and (iv) the arbitrage effect.

Life-cycle effect

Benefits of flexibility increase if baseline amortization payments are more frontloaded. If mortgage maturity is 10 years instead of 12 years, minimum amortization increases from 833 EUR to 1,000 EUR. Consequently, the benefits of flexibility increase from η_0 to $\eta_{\text{lifecycle}} = 2{,}669$ EUR. Flexibility becomes more beneficial because the shorter maturity makes the life-cycle distribution of amortization payments less optimal.

Impatience effect

Benefits of flexibility increase if the household is more impatient. If the discount factor decreases from 0.97 to 0.96, the benefits of flexibility increase to $\eta_{\text{impatient}} = 2{,}823$ EUR. The impatient household places more value on the high consumption when young that flexibility allows.

Option effect

Benefits of flexibility increase if income uncertainty is higher. I double the standard deviation of the transitory income shock from 0.2 to 0.4 and reduce the replacement rate of the worst income realization from 0.6 to 0.4. Consequently, the benefits of flexibility increase to $\eta_{\text{uncertainty}} = 2{,}274$ EUR. The benefits of flexibility increase because precautionary savings become more valuable.

Arbitrage effect

Benefits of flexibility increase if the household uses unsecured credit. If I reduce initial net liquid assets from +6,000 EUR to -1,000 EUR, the benefits of flexibility increase to $\eta_{\text{arbitrage}} = 2{,}203$ EUR. This figure is an understatement of the relative benefits in utility terms, because the marginal cost of giving up liquid assets is higher with lower initial assets. The benefits of flexibility increase because flexibility provides an arbitrage opportunity to repay expensive unsecured credit by extending the mortgage.

5 Model results

The basic model predicts that all households apply for flexibility. To understand limited demand, this section solves and simulates the inertia and commitment models for a sample of 1,000 households to evaluate if the two model variants can explain the key reduced-form findings.

5.1 Evaluating inertia and commitment models

To evaluate whether the inertia and commitment models can explain the key reduced-form findings on application rates and consumption behavior, I predict behavior in the two model variants for heterogeneous households. For each individual household, I solve the model separately because of heterogeneity in model parameters such as minimum amortization payment or the mortgage interest rate.

Because of computational limits, I solve the inertia and commitment models for a sample of 1,000 households. These 1,000 households are a random subsample of all households for whom (i) model variables have a non-missing empirical counterpart, (ii) empirical variables are unlikely to suffer from significant measurement error (I omit outliers), and (iii) the flexibility offer is not trivially insignificant (for instance because of high financial assets). I use the following criteria to filter the main sample of households defined in section 2.2:

1. Household is between 25 and 60 years.
2. Financial assets other than deposits are less than 10,000 EUR.
3. Net liquid assets are between -10 and +15 times monthly income.
4. Household is not over their unsecured credit limit.
5. Minimum amortization is between 2.5 and 50 percent of monthly disposable income.
6. Remaining mortgage maturity is between 1 and 30 years and the mortgage needs to be repaid before age 75.
7. The initial mortgage balance is between 2 and 100 times monthly income.
8. The unsecured credit limit is below 10 times monthly income.

These restrictions reduce the population of households with a mortgage from 204,246 to 138,138. The filters drop particularly households with limited incentives to apply for flexibility (for instance those with high assets). As a result, 24.9 percent of households in this narrower population apply (up from 21.7 percent in the main sample). I draw the random sample of 1,000 households from this narrower population.

5.2 Results from the inertia model

Benefits of flexibility and predicted application rates

Figure 6 and Table 8 present the distribution of benefits of flexibility (η) in the inertia model for the sample of 1,000 households. The mean benefit is 1,512 EUR and the median benefit is 1,265 EUR. The model captures relevant information for the household decision, because the benefit of flexibility for the median applicant is 1,812 EUR versus 1,122 EUR for the median non-applicant (Table A.1).

The distribution of benefits allows calculation of how large a non-pecuniary application cost would equalize the observed and predicted application rates. In the sample of 1,000 households, 24 percent actually apply for flexibility. Table 9 presents the share of households the inertia model predicts apply given a range of non-pecuniary application costs. With no application cost, the inertia model coincides with the basic model and predicts that all households apply. To match the observed application rate in the sample of households, the inertia model requires a marginal application cost of 2,336 EUR.[26] In the subsample of liquidity-constrained households, the inertia model requires a marginal application cost of 2,222 EUR to match the observed application rate of 36 percent. The required marginal application cost is 61 percent of the median monthly disposable income in the sample.

The results above do not consider that some households may have been inattentive to the offer, which may overestimate the non-pecuniary application cost that rationalizes non-application. Therefore, I calculate the benefits of flexibility for a second random sample of exclusively employee households ($N = 1{,}000$), for whom inattention is not a confounder, to study if the inertia model can explain non-application among employees by smaller potential benefits. Yet, the benefits of flexibility among non-applicants are actually larger for employee households than for regular households in the inertia model (Table 10). Among employees who do not actually apply, the mean potential benefit is 1,905 EUR and the median 1,647 EUR.

The size of the potential benefits poses a challenge for the inertia model to explain the first key finding that a minority of (attentive) employee-households apply, and the second key finding that a minority of liquidity-constrained households apply. Although the inertia model can match any overall application rate without any restrictions in the non-pecuniary application cost, the derived potential benefits are large both in absolute terms and relative to findings in previous literature. For instance, the mean potential benefit among employees who do not actually apply (1,905 EUR), is larger than the Andersen et al. (2015) estimate of the mean psychological cost of mortgage refinancing in Denmark (10,400 DKK $\approx$ 1,400 EUR).

[26]The required marginal cost equals the benefits of flexibility for the household for whom the size of the benefits equals the 76 percentile of all households. Therefore, 24 percent of households have higher benefits than the marginal application cost, which matches predicted and observed application rates.

Yet, the burden of mortgage refinancing for the average household is arguably larger than the burden of applying for flexibility for a bank employee. Although the benefits of flexibility depend on the model calibration, many aspects of the calibration tend to underestimate the benefits of flexibility.[27]

The inertia model cannot account for the third key finding that many households prefer short flexibility policies. For any application cost, a household in the inertia model either prefers non-application or the 12-month to the 6-month flexibility policy, because benefits of flexibility increase with the length of flexibility for households without self-control problems. Table 11 describes the potential benefits of extending the flexibility period from 6 months to 12 months for the subsample of households who apply for a flexibility policy of 1 to 6 months.[28] Although the sample size is low, because only 9.1 percent of sample households apply for a flexibility policy less than or equal to six months, the inertia model suggests that households who actually apply for short flexibility forego a substantial amount of potential benefits (median foregone benefits 695 EUR).

Consumption behavior at the end of flexibility

The inertia model with time-consistent CRRA preferences is unable to match the consumption profile at the end of flexibility for applicants who are liquidity constrained before the offer. The inertia model predicts that households who are liquidity constrained before the offer smooth consumption at the end of flexibility, whereas in the data, consumption drops discontinuously (Figure 7). Consequently, the inertia model is unable to match the fourth key finding regarding consumption behavior at the end of flexibility. Robustness checks (section 6) show that higher impatience ($\delta \ll 1$) does not solve the problem.

[27]Sources of potential underestimation of benefits include: i) assumption of no downsizing of housing; ii) no crowding out of more expensive collateralized borrowing for durables purchases; iii) calibration of permanent income growth from cross-section implying no income growth between generations. On the other hand, the assumption of no permanent income shocks may overestimate the benefits of flexibility.

[28]Table 11 underestimates the additional benefits of extending flexibility to 12 months for households who apply for a flexibility policy shorter than six months.

5.3 Results from the commitment model

Benefits of flexibility and predicted application rates

Households benefit less from flexibility in the commitment model than in the inertia model (Figure 6 and Table 8). The mean benefit is 1,256 EUR (1,512 EUR) and the median benefit 268 EUR (1,265 EUR) in the commitment (inertia) model. The median benefit is almost five times smaller in the commitment model than in the inertia model. Flexibility is less beneficial in the commitment model because (i) the present-biased household discounts heavily utility from future consumption, and (ii) the present-biased household knows that future selves are also present biased and overconsume during flexibility.

Because benefits of flexibility are smaller in the commitment model, a lower non-pecuniary application is sufficient to explain non-application (Table 9). With no application cost, 15 percent of households prefer to commit to strictly positive minimum amortization payments. Hence, present-biased preferences cannot alone explain the observed application rate in the baseline calibration of the commitment model ($\beta = 0.7$, $\delta = 0.99$, $\rho = 1.5$). But, for a range of application costs, the commitment model always predicts a lower application rate than the pure inertia model without self-control problems. To match the observed application rate in the sample of households (24 percent), the commitment model requires a marginal application cost of 937 EUR (2,336 EUR in the inertia model).

The commitment model is unlikely to describe the behavior of households with significant liquid assets, because households with self-control problems struggle to keep liquid assets. By contrast, self-control problems can rationalize liquidity-constrained homeowners: the wealthy-hand-to-mouth. The commitment model predicts that fewer liquidity-constrained households apply for a given application cost than the inertia model. A marginal application cost of 1,279 EUR equates the predicted application rate in the commitment model with the observed application rate for liquidity-constrained households (36 percent). This cost is lower than the marginal cost of 2,222 EUR in the inertia model. Therefore, present-biased preferences allow the commitment model to explain the second key finding on low application rates among liquidity-constrained households with a lower application cost than the inertia model.

The commitment model also predicts that some households prefer short flexibility (6 months) to maximum flexibility (12 months) or no flexibility at all. With no application cost, 11 percent of present-biased households apply for a short flexibility policy versus 0 percent in the inertia model. Hence, the commitment model can explain the third key finding that some households prefer short flexibility policies.

Consumption behavior at the end of flexibility

The commitment model with present-biased preferences can reproduce the observed consumption drop at the end of flexibility for households who are liquidity constrained before the offer (Figure 7). In the commitment model, households constrained before the offer and predicted to prefer the 12-month flexibility policy reduce consumption by about 6 percent from the last month of flexibility to the second positive minimum amortization month. This discontinuous consumption drop resembles the empirical findings from the event-study regression. Present-biased households are unwilling to consume less during the flexibility period to smooth consumption once positive minimum amortization payments resume. Consequently, the commitment model with present bias can explain the fourth key finding on consumption behavior at the end of flexibility.

6 Robustness

This section studies (i) the robustness of the reduced-form findings, (ii) sensitivity of model predictions to model calibration, and (iii) alternative hypotheses for the main findings.

6.1 Robustness of reduced-form findings

Consumption smoothing event study with matched sample

In the event-study regression on consumption smoothing at the end of flexibility, I used the full sample of non-applicants as controls to sweep out monthly variation in consumption. Yet, because non-applicants are systematically different from applicants, the consumption profile for applicants could reflect a confounding event (for instance legislative change) that affects applicants and non-applicants differentially and coincides with the end of the flexibility policy. Another event is unlikely to explain the consumption profile at the monthly frequency though, particularly because flexibility policies do not all end in the same month, because the sign-up window was five months.

To further address the concern of a confounding event, I rerun the event-study regression with a matched-on-observables group of non-applicants as controls. For each applicant household, I first find an exact match from the pool of non-applicants by (i) the number of adults and children, (ii) the age decile of adults, (iii) the urbanization category of the municipality (urban/semi-urban/rural), (iv) employee status, and (iv) an indicator variable of liquidity constraints. Within the group of potential non-applicant matches, I use nearest-neighbor matching based on application propensity score to further balance covariates. Matching is with replacement; that is, some non-applicants are matched to multiple applicants.

Figure A.1 and Table A.2 present results on consumption behavior at the end of flexibility with the matched sample of non-applicants as controls. The qualitative pattern is the same even though the consumption drop for constrained applicants is somewhat smaller than in the baseline estimates. The conclusion remains that liquidity-constrained applicants reduce consumption discontinuously at the end of flexibility.

6.2 Sensitivity of model predictions to model calibration

Explaining consumption drop with high impatience

This section studies whether impatience can explain the consumption drop at the end of flexibility without any self-control problems. I solve the inertia model with no self-control problems but varying levels of the long-run discount factor δ and compare the predicted consumption path with the data.

Figure A.2 plots the consumption path for $\delta \in [0.7, 0.8, 0.9, 0.97]$, where $\delta = 0.97$ is the baseline calibration. A value of δ of approximately 0.7 matches the eventual decrease in consumption after 4 to 5 months since the end of flexibility. But even low values of δ, implying high impatience, do not create the discontinuous consumption drop at the end of flexibility observed in the data or in simulations of the present-biased commitment model. Instead, highly impatient households have decreasing but smooth consumption profiles.

In addition to not explaining the discontinuity in consumption, the assumption of high impatience is problematic because high impatience significantly increases the benefits of flexibility. Table A.3 presents the distribution of benefits of flexibility for different values of δ. For $\delta = 0.8$, already the lowest 5th percentile of benefits is 1,373 EUR, and the 5th percentile is 1,917 EUR for $\delta = 0.7$. Consequently, almost everyone should apply for flexibility if households are highly impatient but do not have self-control problems.

Benefits of flexibility with higher expected interest rates

Although the baseline calibration of the inertia model requires large non-pecuniary application costs to rationalize the extent of non-application, pessimistic expectations about future interest rates could explain low application rates. The more households expect interest rates to rise, the less beneficial is flexibility, because decreasing mortgage amortization will lead to high interest payments later.

I evaluate particularly pessimistic expectations according to which the Euribor reference rate converges to a steady state of 6 percent within two years. The 6 percent level is the stress-test value at which the bank evaluates the borrowing capacity of households in loan negotiations. I keep inflation expectations constant, leading to a one-to-one increase in expected real interest rates. Table A.4 presents the distribution of benefits of flexibility given these pessimistic expectations relative to the baseline of the steady-state Euribor at the historical average of 3.5 percent. Benefits of flexibility decrease significantly with the mean and median benefit in the inertia model in the high-interest-rate scenario similar to benefits in the commitment model with baseline interest rate expectations.

Although pessimistic expectations about future interest rates can rationalize low application rates with lower non-pecuniary application costs, interest rate expectations cannot alone account for the popularity of short flexibility policies or the consumption drop at the end of flexibility. A household with pessimistic expectations but without self-control problems (i) always prefers 12-month to 6-month flexibility, and ii) smooths consumption at the end of the flexibility period. Consequently, pessimistic expectations are insufficient to explain the key reduced-form findings.

6.3 Alternative hypotheses for main findings

Low financial literacy

Low financial literacy could explain why households do not apply for flexibility or the preference for short flexibility policies if households do not understand the terms of the offer.

Yet, the behavior of bank-employee households suggests low financial literacy is an insufficient explanation for the key findings. As shown earlier, most employee households do not apply, even though bank employees should understand the offer made by their employer. In addition, a significant share (32 percent) of employee applicants prefer short flexibility policies (43 percent among all applicants).

The preference for short flexibility policies could also reflect that households with low financial literacy exhibit random noise in their selection of the length of the flexibility policy. The two default lengths for the flexibility policy were 6 and 12 months. Noise could explain why some choose 6-month policies, because the 6-month option was prominently displayed and hence salient to households. But households were free to choose a non-default length other than 6 and shorter than 12 months. Because 18 percent of applicants actively choose such a non-default length, random noise is unlikely to explain the preference for short flexibility.

Intra-household bargaining

A household may not apply for flexibility, because household members have different preferences or do not trust each other (see for instance Ashraf, 2009; Chiappori and Mazzocco, 2017). Intra-household bargaining because of conflicts of interest could also explain the preference for short flexibility policies as a compromise.

I show in a companion paper that intra-household bargaining does influence decisions in certain households (Vihriälä, 2019). In particular, an individual weighs more his/her own financial situation than the situation of his/her partner in the decision to apply for flexibility. Yet, this finding only holds for households in which members have individual mortgages. Conversely, in households with joint mortgages (the norm), the distribution of financial assets and debts within the household does not influence the application probability.

If intra-household bargaining explained limited demand for flexibility, we would expect single-adult households to be more likely to apply and less likely to prefer short flexibility policies. Yet, the application rate is 21 percent among single-adult households versus 22 percent in the full sample. In addition, the share of shorter than maximum flexibility policies among applicants is 45 percent in single-adult households versus 43 percent in the full sample. Because application patterns are similar in households with and without potential conflicts of interest, intra-household bargaining is unlikely to explain why most households do not apply for flexibility.

Application stigma

Another hypothesis for the low application rate is that households worry about a stigma if they apply for flexibility. For instance, a household could worry that application would lead to worse terms on future borrowing, because the bank would consider the household as a less reliable borrower.

Although private considerations of households are unobservable, the stigma hypothesis does not fit the public portrayal of the flexibility offer. First, the bank explicitly stated that flexibility would not have any future repercussions in terms of higher interest rates or other borrowing costs. Furthermore, the bank portrayed applying for the offer as a prosocial endeavor. At the time of the offer, the Finnish economy had been stagnant for several years. The bank framed the offer as a joint endeavor to boost the economy by encouraging households to spend. Therefore, the stigma hypothesis is opposite to the actual framing of the offer.

Finally, even if worries about a stigma may have deterred some households from applying, stigma struggles to explain the preference for short flexibility or, in particular, the consumption drop at the end of flexibility.

7 Conclusions

This paper has studied demand for flexibility in debt repayment with a natural experiment that gave households a free option to reduce minimum mortgage amortization to zero for 1 to 12 months. A small minority apply for debt-repayment flexibility, although a standard life-cycle model of optimal debt repayment implies substantial benefits. Inattention and inertia can explain why some households do not apply but cannot account for the preference for short flexibility policies, or the consumption behavior at the end of flexibility. By contrast, the commitment model with sophisticated present-biased households can explain the preference for short flexibility policies, and the discontinuous consumption drop at the end of flexibility for households who are liquidity constrained before the offer. Present bias also reduces the benefits of flexibility, which allows the commitment model to match the observed application rates with a lower non-pecuniary application cost than the pure inertia model without present bias.

Evidence consistent with commitment qualifies how policymakers should approach situations in which default options impact household decisions. Badly designed default options together with inattention and inertia can harm households if the default option leads to, for instance, inadequate retirement savings, high revolving credit card debt balances, or slow mortgage refinancing. Yet, in other settings, commitment can rationalize default effects similarly to inattention or inertia. But whereas policymakers should help households overcome inaction because of inattention or inertia, policymakers should facilitate inaction because of a desire for commitment. Flexibility does not need to be impossible to enable commitment – instead, a sufficient delay in the benefits of flexibility can enable commitment for households with self-control problems.

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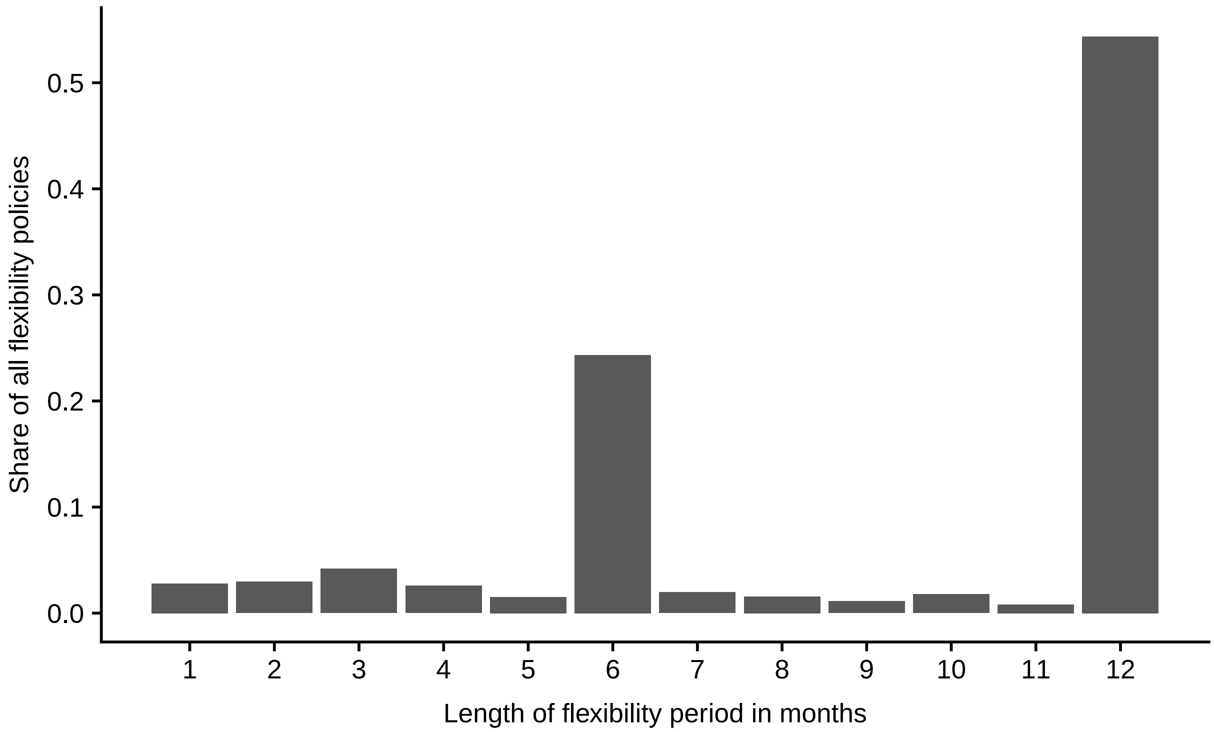
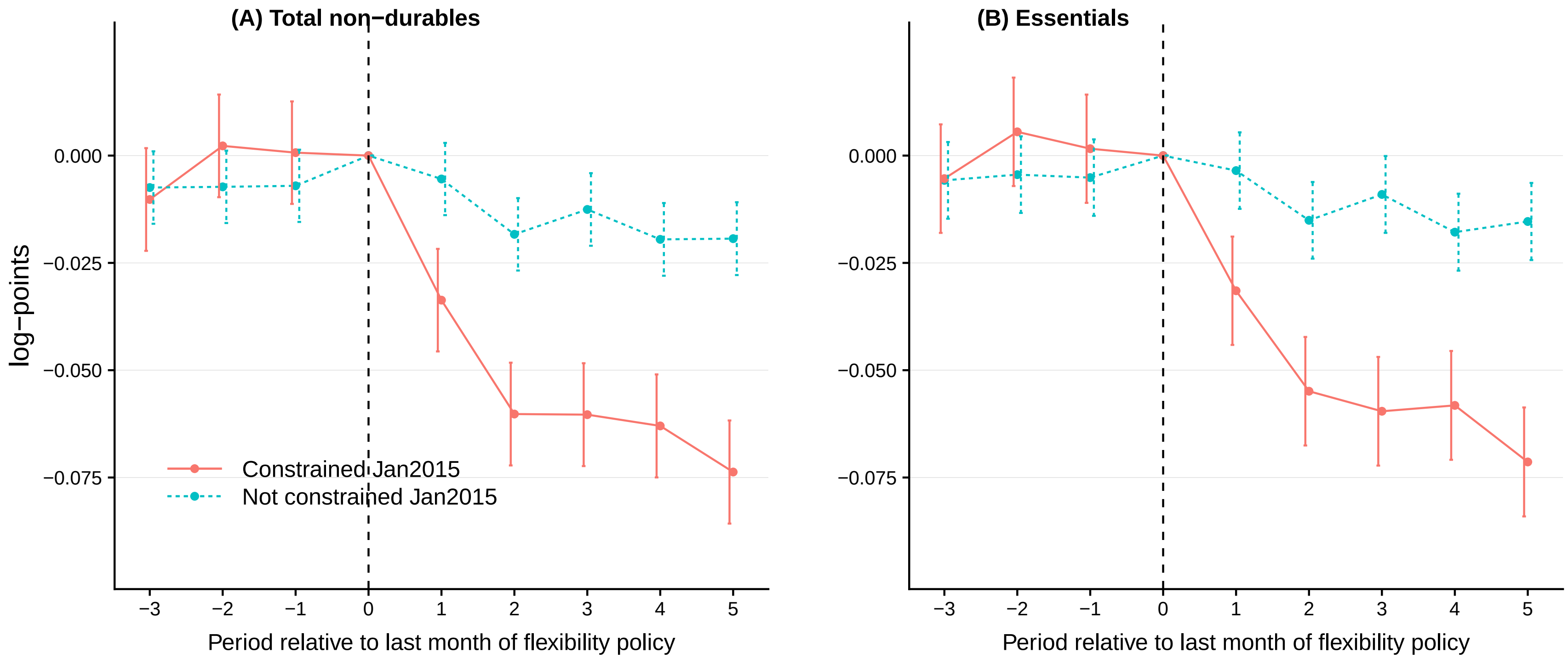


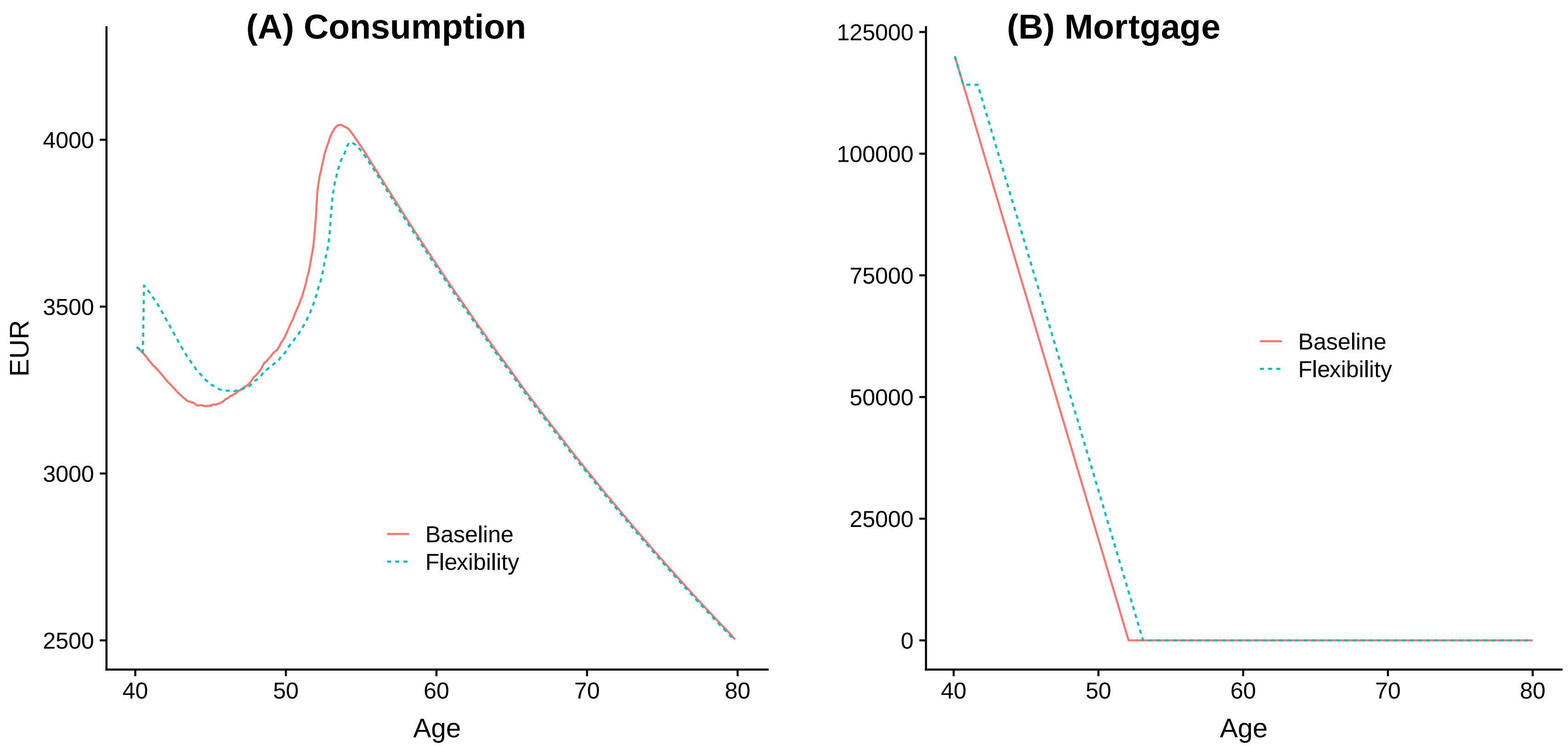
Note: The figure plots the popularity of flexibility policies of different lengths among applicants. The share of applications for policies shorter than maximum is 46 percent.

Figure 1: Almost half of applicants choose a flexibility policy shorter than maximum



Note: The figure plots estimated delta coefficients from equation 1. Panel A depicts results from regressions with logarithm of total non−durable expenditure as the dependent variable. Panel B represents results with logarithm of essentials expenditure (groceries, energy, public transportation, gasoline) as dependent variable. For each dependent variable I estimate equation 1 separately for households who are liquidity constrained before offer announcement and for unconstrained households. Applicant households include those who apply for a 12−month flexibility policy so that time from the start of the flexibility policy is the same for all applicants. I remove monthly variation in consumption by using non−applicants as controls. Period 0 refers to the last month of the flexibility policy. Vertical bars represent 95 percent confidence intervals.

Figure 2: Event study: liquidity-constrained applicants do not smooth consumption at the end of flexibility



Note: These figures depict simulations of the basic model of an example household with CRRA preferences and no self−control problems. Flexibility allows the household to increase consumption when young, at the cost of lower consumption later. The household finances the increase in consumption when young by decreasing mortgage amortization during the flexibility period.

Figure 3: Basic model simulations: Under flexibility, the household consumes more when young and repays mortgage more slowly

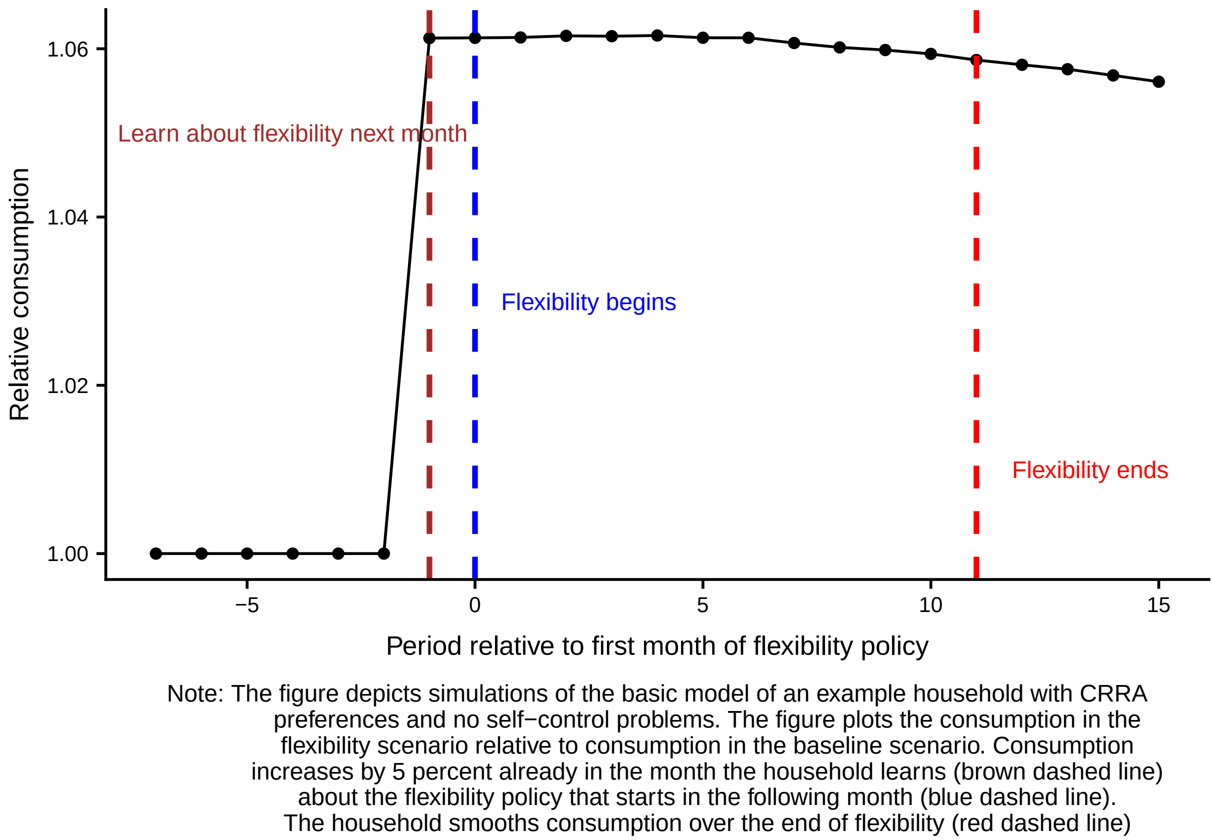
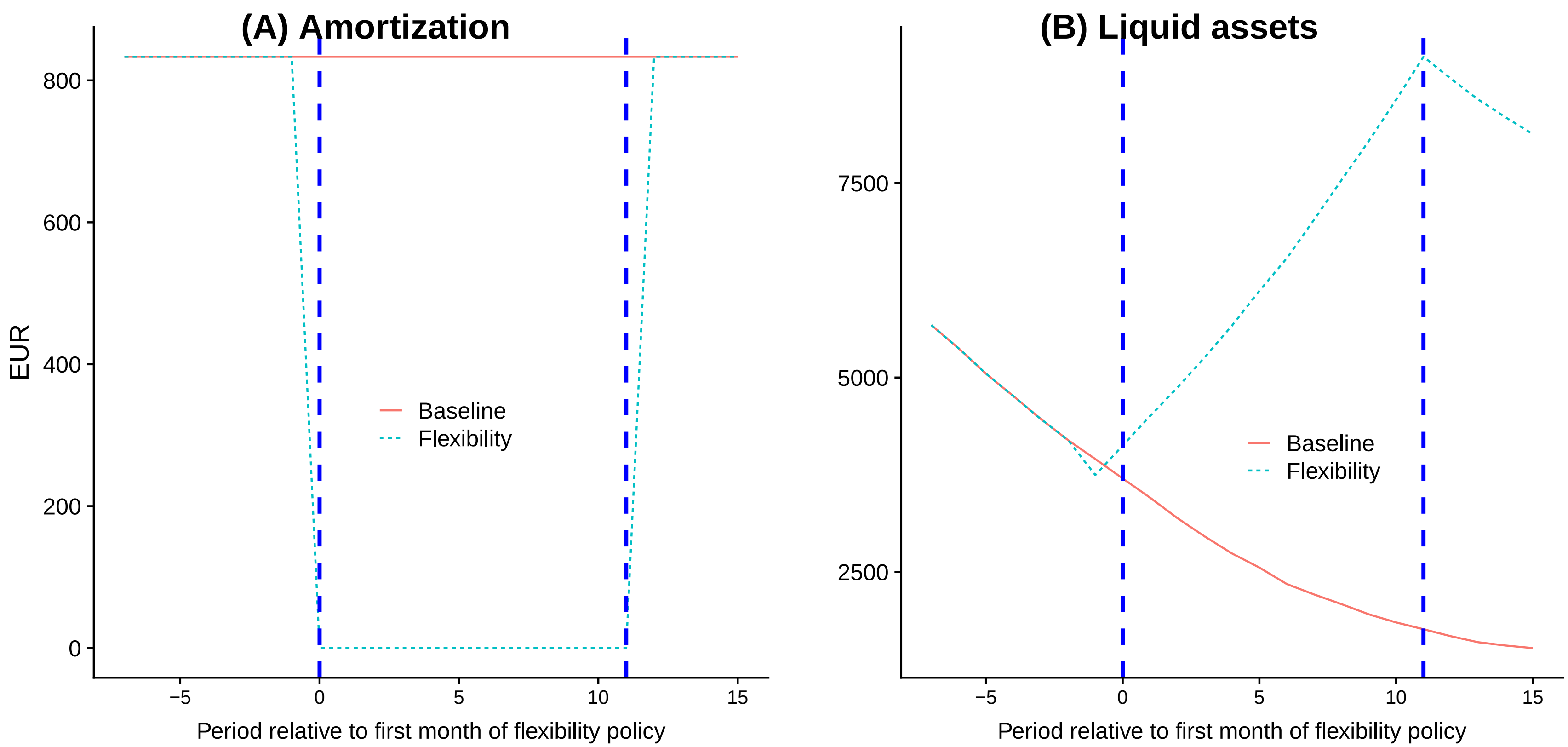
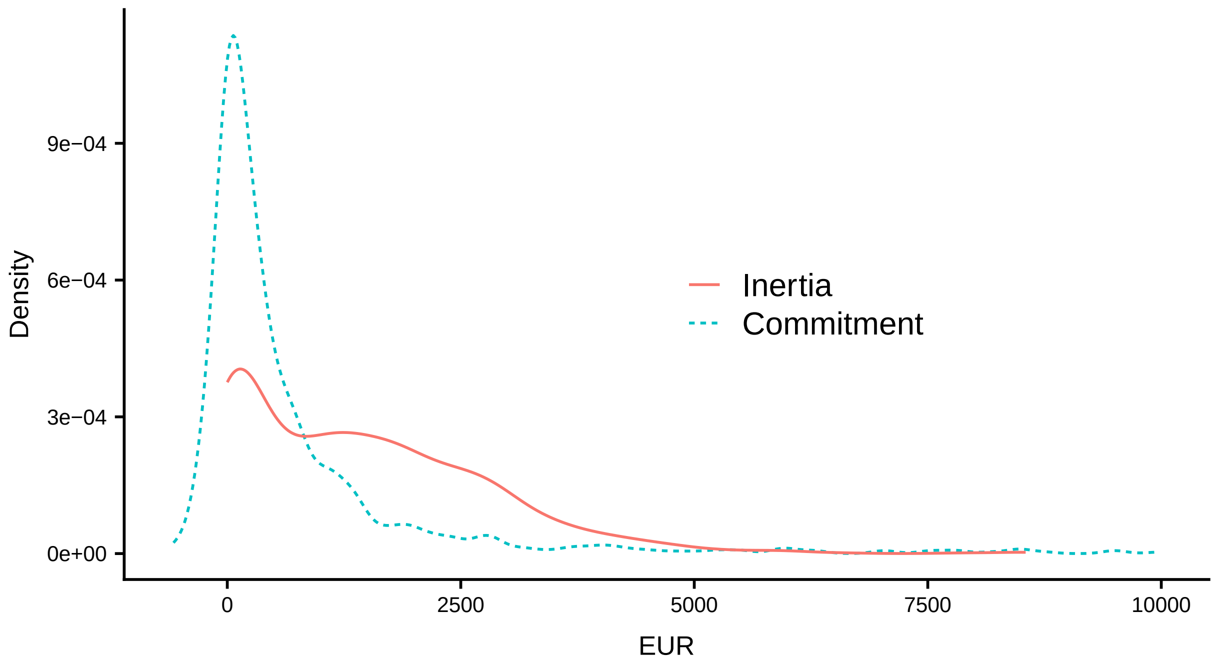


Figure 4: Basic model simulations: Household increases consumption in the flexibility scenario and smooths consumption at the end of flexibility



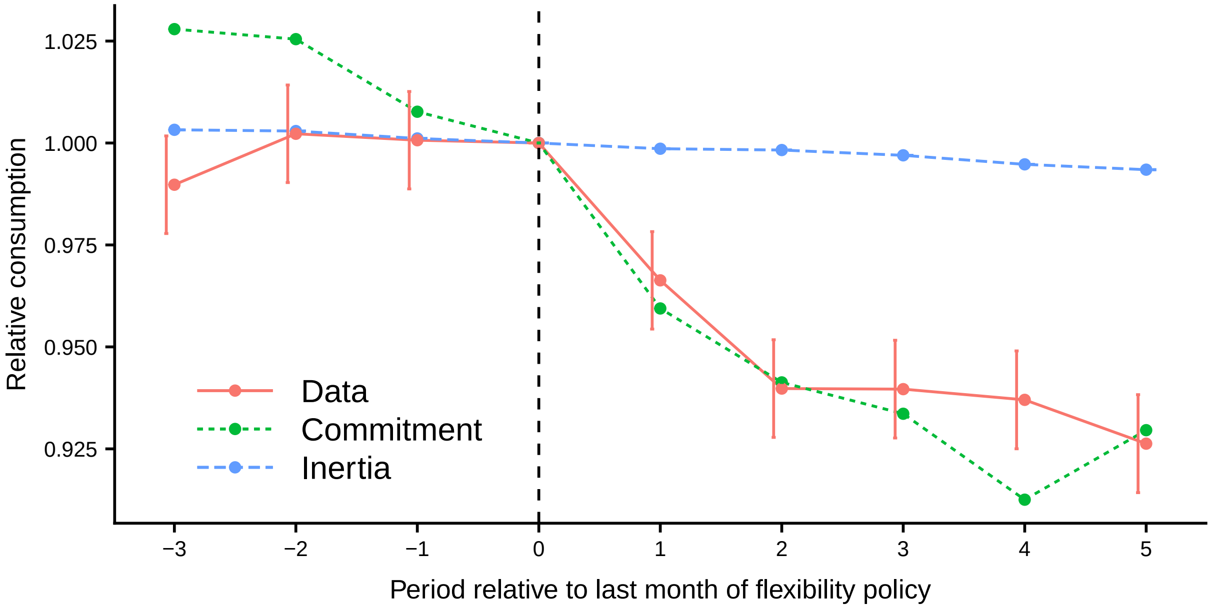
Note: These figures depict simulations of the basic model of an example household with CRRA preferences and no self−control problems. Immediately as the flexibility policy sets in, the household stops mortgage amortization. Liquid assets increase to smooth consumption as the household does not want to consume all savings from reduced amortization payments immediately.

Figure 5: Basic model simulations: During the flexibility period, the household stops amortization and increases liquid assets to smooth consumption



Note: The figure presents the distribution of the benefits of flexibility in the commitment and inertia models for the sample of 1,000 households for whom I solve both models. The measure of benefits is the amount of liquid assets in EUR that the household would give up to keep flexibility instead of needing to make positive minimum amortization payments. For legibility, I have omitted households with benefits larger than 10 000 EUR (less than 4 percent in both models).

Figure 6: Benefits of flexibility in the inertia and commitment models



Note: The figure plots average consumption per period relative to average consumption in the last period of the 12−month flexibility policy using simulations from the inertia and commitment models. I calculate the average consumption path among households who (i) were liquidity constrained before the offer in January 2015; and (ii) prefer the 12−month flexibility policy in the commitment model. I compare the model predictions to reduced−form estimates from the event−study regression for households who are liquidity constrained before the offer. The reduced−form estimates include 95 percent confidence intervals.

Figure 7: The commitment model, unlike the inertia model, reproduces the consumption drop at the end of flexibility for applicants who are liquidity constrained before the offer

Table 1: Descriptive statistics for main variables

	N=204,246							
	Mean	SD	Q0.01	Q0.25	Median	Q0.75	Q0.99	Unit
Apply (0/1)	0.22	0.41	0.00	0.00	0.00	0.00	1.00	Share
Demographics								
Adults	1.85	0.63	1.00	1.00	2.00	2.00	4.00	Number
Children	0.73	1.08	0.00	0.00	0.00	1.00	4.00	Number
Age	45.34	12.18	25.00	35.50	44.00	54.00	74.50	Years
Female	0.51	0.27	0.00	0.50	0.50	0.50	1.00	Share
Mortgage/housing								
Mortgage value	93,792	77,105	2,000	35,959	77,742	131,967	342,118	EUR
Amortization size	634	417	75	364	545	805	2,060	EUR/month
Interest rate	1.33	0.52	0.25	0.98	1.25	1.64	2.57	Percent
Margin rate	0.90	0.47	0.00	0.55	0.80	1.20	2.01	Percent
Mortgage age	4.71	3.38	0.00	2.00	4.00	7.00	14.00	Years
Remaining maturity	11.15	6.18	0.00	6.00	11.00	16.00	24.00	Years
Property value	195,013	132,953	36,039	112,101	164,282	242,147	669,549	EUR
Net housing equity	101,220	105,227	-35,308	36,029	79,309	138,667	466,788	EUR
Income and expenditure								
Disposable income	3,647	1,676	825	2,404	3,517	4,506	9,270	EUR/month
Card expenditure	1,804	1,024	276	1,040	1,683	2,375	4,798	EUR/month
Financial assets								
Deposits	13,298	30,164	-1,355	1,939	5,697	15,008	107,364	EUR
Other assets	7,157	197,738	0	0	0	2,066	111,669	EUR
Other credit								
Total unsecured credit	1,916	2,666	0	87	874	2,637	12,020	EUR
Interest-paying unsecured credit	1,465	2,558	0	0	0	1,895	11,452	EUR
Credit card utilization	0.37	0.36	0.00	0.03	0.26	0.71	1.00	Pct of limit

[a] All variables except disposable income are determined before offer announcement in February 2015. Most variables refer to end-of-January 2015 values, but card expenditure is a monthly average over 2014.

[b] Disposable income is average monthly labor income after taxes based on administrative tax information for 2015.

[c] The amortization measure is the default minimum amortization payment due after the announcement of the flexibility offer. The measure is a monthly average of minimum amortization payments due from February 2015 to June 2016.

[d] Total unsecured credit includes both interest-paying unsecured credit and the part of unsecured credit with interest-free period.

Table 2: Characteristics of households by offer application

	Unit	Apply (N=44,292)			Do not apply (N=159,954)		
		Mean	SD	Median	Mean	SD	Median
Demographics							
Adults	Number	1.87	0.62	2.00	1.85	0.63	2.00
Children	Number	0.94	1.19	0.00	0.67	1.04	0.00
Age	Years	43.09	11.03	41.00	45.96	12.41	45.00
Female	Share	0.51	0.26	0.50	0.51	0.27	0.50
Mortgage/housing							
Mortgage value	EUR	117,231	74,418	104,356	86,100	70,175	70,173
Amortization size	EUR/month	726	387	644	601	369	517
Interest rate	Percent	1.25	0.51	1.20	1.35	0.52	1.28
Margin rate	Percent	0.84	0.46	0.75	0.92	0.48	0.80
Mortgage age	Years	4.79	3.11	4.14	4.69	3.45	4.00
Remaining maturity	Years	12.66	5.50	13.00	10.74	6.29	10.47
Property value	EUR	204,571	119,451	176,076	189,444	116,188	161,014
Net housing equity	EUR	87,759	87,215	67,891	103,193	91,675	82,573
Income and expenditure							
Disposable income	EUR/month	3,621	1,584	3,519	3,654	1,701	3,517
Card expenditure	EUR/month	1,845	937	1,757	1,781	966	1,661
Financial assets							
Deposits	EUR	6,872	12,084	2,919	14,105	19,502	6,917
Other assets	EUR	3,147	11,951	0	5,556	16,575	0
Other credit							
Total unsecured credit	EUR	2,882	2,984	1,902	1,614	2,325	664
Interest-paying unsecured credit	EUR	2,364	2,927	1,271	1,182	2,200	0
Credit card utilization	Pct of limit	0.53	0.36	0.57	0.33	0.34	0.20

[a] All variables except disposable income are determined before offer announcement in February 2015. Most variables refer to end-of-January 2015 values, but card expenditure is a monthly average over 2014.

[b] Disposable income is average monthly labor income after taxes based on administrative tax information for 2015.

[c] The amortization measure is the default minimum amortization payment due after the announcement of the flexibility offer. The measure is a monthly average of minimum amortization payments due from February 2015 to June 2016.

[d] Total unsecured credit includes both interest-paying unsecured credit and the part of unsecured credit with interest-free period.

[e] I winsorize euro variables below the 1st percentile and above the 99th percentile.

Table 3: Predicting application: linear probability model
(application rate = 0.22; N = 204,246; R^2 = 0.12)

Predictor	Group	Estimate	T-statistic	P-value
Age	Q2	0.00	0.93	0.35
	Q3	0.00	1.65	0.10
	Q4	-0.01	-2.78	0.01
Deposits	Q2	-0.05	-19.14	0.00
	Q3	-0.11	-38.86	0.00
	Q4	-0.17	-58.46	0.00
Total unsecured credit	Q2	0.02	5.66	0.00
	Q3	0.05	10.80	0.00
	Q4	0.10	18.49	0.00
Credit card utilization	Q2	0.01	1.98	0.05
	Q3	0.02	3.85	0.00
	Q4	0.08	13.87	0.00
Disposable income	Q2	-0.03	-11.79	0.00
	Q3	-0.07	-21.71	0.00
	Q4	-0.11	-28.51	0.00
Card expenditure	Q2	0.00	1.86	0.06
	Q3	0.01	2.68	0.01
	Q4	0.01	3.58	0.00
Amortization size	Q2	0.05	20.78	0.00
	Q3	0.08	30.29	0.00
	Q4	0.14	40.73	0.00
Property value	Q2	0.00	-0.17	0.86
	Q3	-0.01	-4.01	0.00
	Q4	-0.03	-8.59	0.00
Mortgage value	Q2	0.05	21.41	0.00
	Q3	0.08	26.69	0.00
	Q4	0.13	34.62	0.00
Interest rate	Q2	-0.03	-10.57	0.00
	Q3	-0.05	-17.30	0.00
	Q4	-0.05	-16.24	0.00
Household includes bank employee		0.11	19.94	0.00

[a] The table presents estimates from a linear probability model in which the dependent variable is 1 if household applies for flexibility and 0 otherwise

[b] The omitted category for binned variables is the bottom quartile

[c] The regression includes additional controls for number of adults and children, municipality and mortgage age but I do not report the coefficients for brevity.

[d] The R^2 of the linear probability model is the difference in the mean predicted application probability by application status

[e] Standard errors robust to heteroskedasticity

[f] Total unsecured credit includes both interest-paying unsecured credit and the part of unsecured credit with interest-free period.

Table 4: Attention to household finances correlates positively with application

	Dependent variable:	
	Apply (0/1)	
	(1)	(2)
Share of online messages read	0.04***	
	(0.002)	
Login Quartile 2		0.03***
		(0.002)
Login Quartile 3		0.05***
		(0.003)
Login Quartile 4		0.08***
		(0.003)
Household controls	Yes	Yes
Application rate	0.22	0.22
Observations	201,164	201,803
R^2	0.12	0.12

Note: *p<0.1; **p<0.05; ***p<0.01

The table presents estimation results from two linear probability models in which the dependent variable is 1 if the household applies for flexibility and 0 otherwise. Model (1) uses the share of online messages read prior to the offer as an attention proxy. Model (2) uses the frequency of logins to online and mobile banking in 2017 (data prior to offer not available). Standard errors robust to heteroskedasticity in parentheses. Both specifications control for household characteristics present in the baseline linear probability model without attention proxies (Table 3). In addition, the regression based on share of online messages read controls for the total amount of messages received. In Model (1) I include households who received at least one online message in 2014. In Model (2) I include households who logged in online at least once in 2017. These conditions explain the small discrepancy in the number of observations relative to the full sample (N = 204,246). The R^2 of the linear probability model is the difference in the mean predicted application probability by application status.

Table 5: Event study: liquidity-constrained applicants do not smooth consumption at the end of flexibility

	Dependent variable:			
	Total non-durables	Total non-durables	Essentials	Essentials
	(1)	(2)	(3)	(4)
9th flexibility month	−0.007*	−0.010*	−0.006	−0.005
	(0.004)	(0.006)	(0.005)	(0.006)
10th flexibility month	−0.007*	0.002	−0.004	0.006
	(0.004)	(0.006)	(0.005)	(0.006)
11th flexibility month	−0.007	0.001	−0.005	0.002
	(0.004)	(0.006)	(0.005)	(0.006)
1st amortization month	−0.005	−0.034***	−0.003	−0.031***
	(0.004)	(0.006)	(0.005)	(0.006)
2nd amortization month	−0.018***	−0.060***	−0.015***	−0.055***
	(0.004)	(0.006)	(0.005)	(0.006)
3rd amortization month	−0.013***	−0.060***	−0.009**	−0.060***
	(0.004)	(0.006)	(0.005)	(0.006)
4th amortization month	−0.020***	−0.063***	−0.018***	−0.058***
	(0.004)	(0.006)	(0.005)	(0.006)
5th amortization month	−0.019***	−0.074***	−0.015***	−0.071***
	(0.004)	(0.006)	(0.005)	(0.006)
Household sample	Unconstrained	Constrained	Unconstrained	Constrained
N(Applicants)	16,784	8,408	16,780	8,408

Note: *p<0.1; **p<0.05; ***p<0.01

The table presents estimates of the delta coefficients in equation 1. The omitted baseline month is the last flexibility month. Models 1 and 2 use the logarithm of total non-durable expenditure as the dependent variable. Models 3 and 4 present results with logarithm of essentials expenditure (groceries, energy, public transportation, gasoline) as the dependent variable. Standard errors clustered by household in parentheses. For each dependent variable I estimate equation 1 separately for households who are liquidity constrained before offer announcement and for unconstrained households. Applicant households include those who apply for a 12-month flexibility policy so that time from the start of the flexibility policy is the same for all applicants. I present the results graphically in Figure 2.

Table 6: Model calibration: parameters common to all households

Parameter	Description	Basic/Inertia model	Commitment model	All models
δ	Long-term discount factor	0.97	0.99	
β	Short-term discount factor	1	0.7	
ρ	Coefficient of relative risk aversion			1.5
r_{save}	Real interest rate on positive liquid assets			1
r_{boro}	Real interest rate on negative liquid assets			7
Γ	Permanent income growth			see Figure A.4
σ_{Ω}	Standard deviation of transitory income shock			0.2
$P(\text{Unemp})$	Unemployment probability			0.083
τ_{Unemp}	Unemployment benefit replacement rate			0.6
τ_{Pension}	Pension replacement rate			0.6

[a] Interest rates refer to initial values. Expected real interest rates rise over time as explained in the main text.

[b] I express the long-term discount factor, interest rates and the standard deviation of the transitory income shock as their yearly equivalents.

[c] Permanent income growth is based on the life-cycle income pattern depicted in Figure A.4.

Table 7: Model calibration: parameters specific to each household based on microdata

	N	Mean	SD	Q0.01	Q0.25	Median	Q0.75	Q0.99	Unit
Household age	1,000	41.2	8.9	25.9	33.9	40.4	48.4	58.9	Years
Initial monthly income	1,000	3,747.9	1,469.9	1,321.6	2,681.3	3,653.1	4,473.3	8,935.5	EUR/month
Initial mortgage balance	1,000	100,751.5	70,923.5	9,175.9	47,525.7	85,976.7	137,132.0	322,400.8	EUR
Initial minimum amortization	1,000	660.1	352.1	137.1	417.1	594.6	826.0	1,812.7	EUR
Initial mortgage interest rate	1,000	1.3	0.5	0.3	1.0	1.2	1.6	2.5	Percent
Initial net liquid assets	1,000	9,010.4	17,824.4	-9,777.7	153.6	4,592.7	12,072.3	75,347.8	EUR
Unsecured borrowing limit	1,000	4,698.2	3,559.8	1,000.0	2,000.0	4,000.0	6,000.0	16,133.3	EUR

[a] The table presents the distribution of household-specific parameters in the sample of 1,000 households for whom I solve the inertia and commitment models.

[b] Household age is the mean age of adults within the household.

Table 8: Benefits of flexibility in the inertia and commitment models

Model	N	Mean	Std. dev.	Q0.05	Q0.25	Median	Q0.75	Q0.95
Inertia	1,000	1,512	1,635	6	246	1,265	2,288	3,918
Commitment	1,000	1,256	3,536	-174	23	268	879	6,368

[a] The table presents key statistics on the distribution of the benefits of flexibility in the commitment and inertia models for the sample of 1,000 households for whom I solve both models.

[b] The measure of benefits is the amount of liquid assets in EUR that the household would give up to keep flexibility instead of needing to make positive minimum amortization payments.

Table 9: Predicted application rates in the inertia and commitment models

			Predicted application rate given non-pecuniary application cost					
Model	Cohort	N	No application cost	250 EUR cost	500 EUR cost	750 EUR cost	1,000 EUR cost	1,500 EUR cost
Inertia	All	1,000	1.00	0.75	0.68	0.63	0.57	0.43
Commitment	All	1,000	0.85	0.52	0.37	0.28	0.23	0.15
Inertia	Constrained	209	1.00	0.88	0.83	0.79	0.73	0.57
Commitment	Constrained	209	0.94	0.77	0.67	0.54	0.45	0.29

[a] The table presents the share of households predicted to apply for flexibility for a given non-pecuniary application costs in the inertia and commitment models. I present the predictions separately for the full sample of 1,000 households for whom I solve both models, and for the subsample of households who are liquidity constrained before the offer. The predicted application rate is the sum of application rates for 6-month and 12-month flexibility policies.

[b] The true application rate in the data for the cohort of all 1,000 households is 24 percent.

[c] The true application rate in the data for the subsample of liquidity-constrained households is 36 percent.

Table 10: Benefits of flexibility for non-applicants in regular versus employee sample in the inertia model

Model	Cohort	N	Mean	Std. dev.	Q0.05	Q0.25	Median	Q0.75	Q0.95
Inertia	Regular households	758	1,387	1,564	5	166	1,122	2,083	3,723
Inertia	Employee households	589	1,905	1,710	21	330	1,647	3,002	5,129

[a] The table presents key statistics on the distribution of the benefits of flexibility in the inertia model for the samples of regular households and employee households. I only consider households who do not actually apply for flexibility.

[b] The measure of benefits is the amount of liquid assets in EUR the household would give up to keep flexibility instead of needing to make positive minimum amortization payments.

Table 11: Households who apply for short flexibility forego substantial benefits

Model	N	Mean	Std. dev.	Q0.05	Q0.25	Median	Q0.75	Q0.95
Inertia	91	833	677	4	278	695	1,333	2,020

[a] The table presents key statistics on the distribution of foregone benefits by households who apply for a flexibility policy of 6 months or less compared to the scenario in which they would apply for maximum flexibility (12 months). I calculate the foregone benefits as the potential benefits from 12-month flexibility minus the potential benefits from 6-month flexibility according to the inertia model.

[b] The table underestimates the foregone benefits for households who apply for a flexibility policy shorter than six months.

A Model solution methods

Solving basic model with CRRA preferences

I solve the household problem numerically by backward induction with techniques developed in Druedahl (2019). In particular, the algorithm divides the solution of optimal consumption and amortization to two separate steps following Druedahl's nested value function iteration (NVFI) approach. The solution algorithm is as follows:

1. Normalize model by permanent income
   - The normalized value function is $v(a_t, m_t)$, where $a_t = A_t/P_t$ and $m_t = M_t/P_t$
2. Solve optimal behavior in last period and calculate value function
   - Consume everything after paying off any remaining mortgage: $c_T = a_T - R_{mort,T} m_t$
   - Final period value function: $v_T(a_T, m_T) = u(c_T)$
3. In next-to-last period, precompute end-of-period value function for grids of end-of-period state variables
   - $w_{T-1}(a^e_{T-1}, m^e_{T-1}) = \delta \mathbb{E}[v_T(a_T, m_T)]$
4. Solve for optimal consumption for grids of post-amortization liquid assets (l_{T-1}) and end-of-period mortgage balance by interpolating end-of-period value function, and create post-amortization value function
   - $v^{post-amort}_{T-1}(l_{T-1}, m^e_{T-1}) = \max_{c_{T-1}} u(c_{T-1}) + w_{T-1}(a^e_{T-1}, m^e_{T-1})$
   - Post-amortization liquid assets are beginning of period liquid assets minus mortgage service: $l_{T-1} = a_{T-1} - \Delta_{T-1} - r_{mort,T-1} m_{T-1}$
   - End-of-period mortgage balance is beginning-of-period balance minus amortization: $m^e_{T-1} = m_{T-1} - \Delta_{T-1}$
5. Solve for optimal amortization (Δ_{T-1}) for grids of beginning-of-period liquid assets and mortgage by interpolating post-amortization value function, and create beginning-of-period value function
   - $v_{T-1}(a_{T-1}, m_{T-1}) = \max_{\Delta_{T-1}} v^{post-amort}_{T-1}(l_{T-1}, m^e_{T-1})$
6. Create interpolated beginning-of-period consumption and amortization functions
7. Move one period backward and start loop again.

In solving the model, the liquid asset grid contains 200 gridpoints and the mortgage grid 120 gridpoints. Furthermore, when solving the model for heterogeneous households, the mortgage grid dynamically accounts for the maximum mortgage balance the household can have in any period given initial mortgage balance and minimum amortization payment. The dynamic mortgage grid increases the precision of the solution for any given number of points in the mortgage grid relative to having a fixed mortgage grid in all periods. In addition, the solution speed increases in periods in which the maximum mortgage balance is zero. The maximum mortgage balance is zero in a given period if the initial mortgage is completely repaid even with minimum amortization in each period. The solution speed increases because the household problem reduces to a one-dimensional consumption problem if maximum mortgage balance is zero.

Solving commitment model with present-biased preferences

With present-biased preferences, the continuation value function considers that the self in period t discounts heavily consumption between t and $t+1$ but is relatively patient between consumption in $t+1$ and $t+2$ and in any subsequent periods.

Therefore, I derive optimal consumption from: $v_t^{post-amort}(l_t, m_t^e) = \max_{c_t} u(c_t) + \beta w_t^{perceived}(a_t^e, m_t^e)$, where the household applies the extra discount factor $\beta < 1$ between current and future periods. On the other hand, the perceived end-of-period value function does not discount subsequent utility flows with the extra β factor: $w_t^{perceived}(a_t^e, m_t^e) = \mathbb{E}_t[u(c_{t+1}) + w_{t+1}^{perceived}(a_{t+1}^e, m_{t+1}^e)]$.

The sophisticated household knows that future selves will exhibit present bias and takes their strategies as given. Therefore the period t self correctly understands that consumption in period $t+1$ is the solution to the maximization problem: $\max_{c_{t+1}} u(c_{t+1}) + \beta w_{t+1}^{perceived}(a_{t+1}^e, m_{t+1}^e)$. A naive household would not realize the present bias of future period selves and would instead expect $\beta = 1$ in the previous equation.

B Self-control problems and demand for commitment

Source of self-control problems: present-biased preferences

The present-biased household values current consumption considerably more than next period consumption. The quasi-hyperbolic discounting function represents this strong preference with a β term that discounts utility in all future periods relative to the current period:

$$U = u(c_1) + \beta[\delta u(c_2) + \delta^2 u(c_3) + \delta^3 u(c_4) + \ldots] \tag{14}$$

Yet, the present-biased household is patient about relative consumption in the future. The discount factor between consumption in period 2 and 3 is the same as for a household without present bias (δ).

Time inconsistency arises as the household transitions to period 2. Now the utility flow is:

$$U = u(c_2) + \beta[\delta u(c_3) + \delta^2 u(c_4) + \delta^3 u(c_5) + \ldots] \tag{15}$$

The household is time inconsistent because the discount factor between periods 2 and 3 is $\beta\delta$ for the period 2 self versus δ for period 1 self. This time inconsistency arises because the household is always inclined to consume in the present.

Predictions of the present-biased model on commitment depend on whether the household is aware of its time inconsistency. The period 1 household's expectation of the 'extra' discount rate applied by the period 2 household measures this awareness. A *sophisticated* household forms expectations correctly: $\mathbb{E}_1[\beta_{2,\text{sophisticated}}] = \beta$. This awareness can lead the sophisticated household to want to limit future flexibility. In contrast, a *naive* household is unaware of its future time inconsistency and would erroneously expect $\mathbb{E}_1[\beta_{2,\text{naive}}] = 1$. Because the naive household would expect future selves to act in its own interests, the naive household would see no reason to limit their flexibility.

Why would present-biased households not prefer flexibility?

I illustrate the preference for commitment with a simple three-period model in which a household makes in period 1 a decision impacting maximum consumption in periods 2 and 3. For simplification, period 1 is a pre-period with no consumption or income and the household has no assets or debt. The household receives income y_p for periods 2 and 3.

I determine the inter-temporal consumption allocation by backward induction. As period 3 is the final period, the household consumes everything it can after repaying any debt: $c_3 = y_3 - \mathrm{R}(c_2 - y_2)$. In period 2, household consumes $c_2 \leq y_2 + \psi$, where ψ is the maximum the household can borrow. The period 2 household consumes as much as possible if the marginal utility of consumption in period 2 at maximum consumption is greater than the discounted marginal utility of consumption in period 3:

$$u'(y_2 + \psi) > \beta\delta u'(y_3 - R\psi) \tag{16}$$

Assume equation 16 holds. Then total utility for the period 1 self is $u(y_2 + \psi) + \delta u(y_3 - R\psi)$. The β term is absent because the period 1 self is patient between period 2 and 3 consumption.

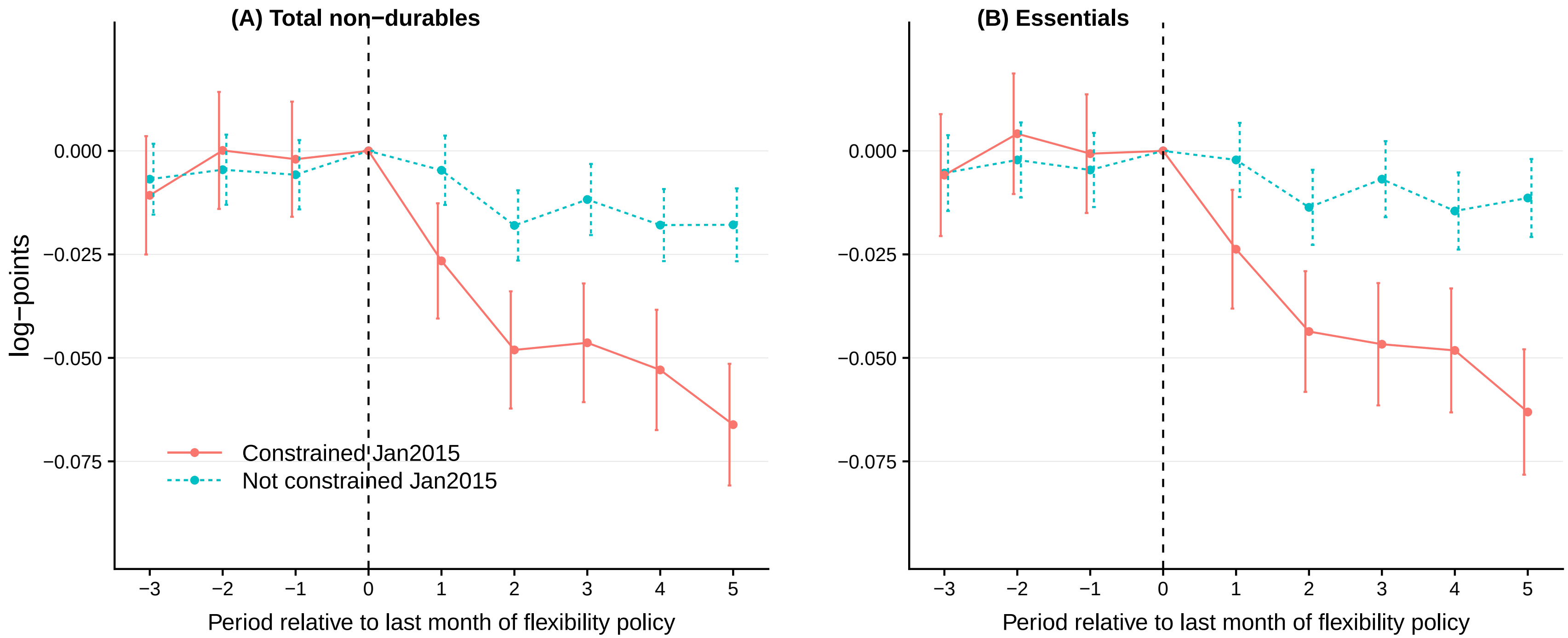
I assume that the period 1 self has a commitment device that regulates how much it is possible to borrow in period 2. If it decides to intervene, it limits period 2 consumption by setting $\psi = 0$. Consequently, total utility is $u(y_2) + \delta u(y_3)$. When deciding whether to limit borrowing, the period 1 self evaluates which inter-temporal allocation maximizes welfare:

$$u(y_2 + \psi) + \delta u(y_3 - R\psi) \lesseqgtr u(y_2) + \delta u(y_3) \tag{17}$$

If the left-hand side is greater than the right-hand side, the period 1 self prefers the *flexibility* of a looser borrowing constraint. Conversely, if the right-hand side is greater, period 1 self prefers to *commit* the period 2 self to not borrowing.

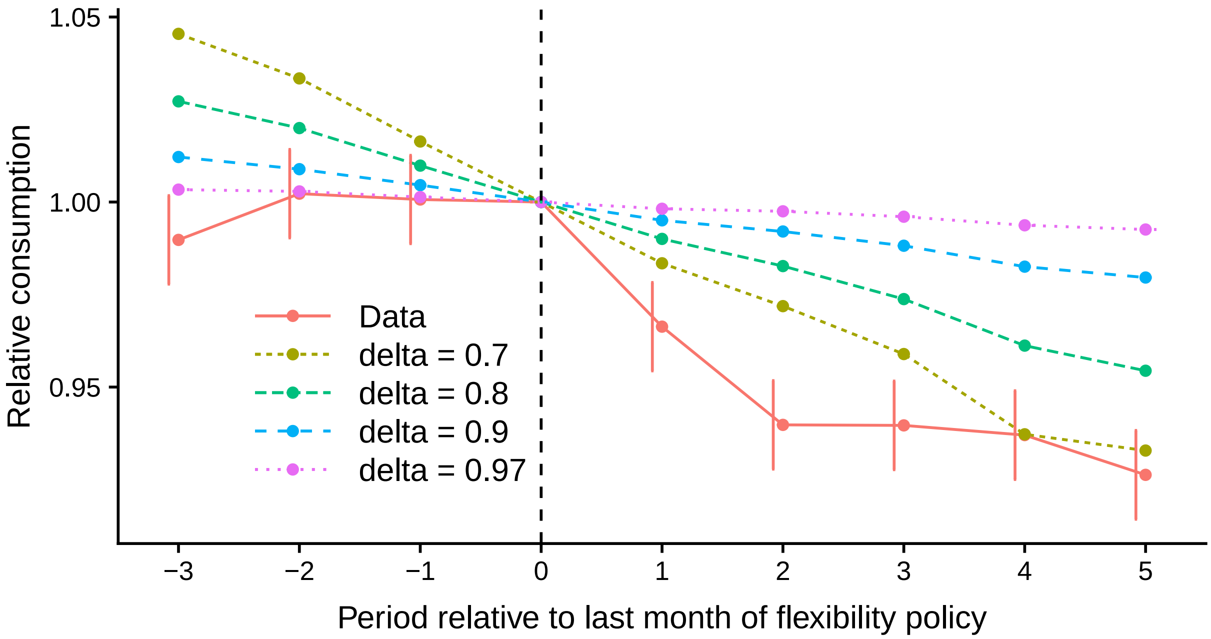
What is preferable to the period 1 self depends on whether income in period 2 is smaller than in period 3. If $y_2 \gg y_3$, then consumption is, whether period 1 self intervenes, considerably larger in period 2. The period 1 self can mitigate the bad inter-temporal allocation by limiting borrowing in period 2. Yet, commitment is sometimes undesirable. If $y_3 \gg y_2$, the period 1 self values the flexibility to borrow in period 2. Otherwise, relative consumption in period 2 is too low.

The illustration is stylized but relevant both for the practical effects of debt repayment flexibility, and the intuition on when commitment is valuable for a present-biased household. Commitment can be valuable to households who would otherwise overconsume relative to lifetime resources. A household enforces commitment by limiting maximum consumption.



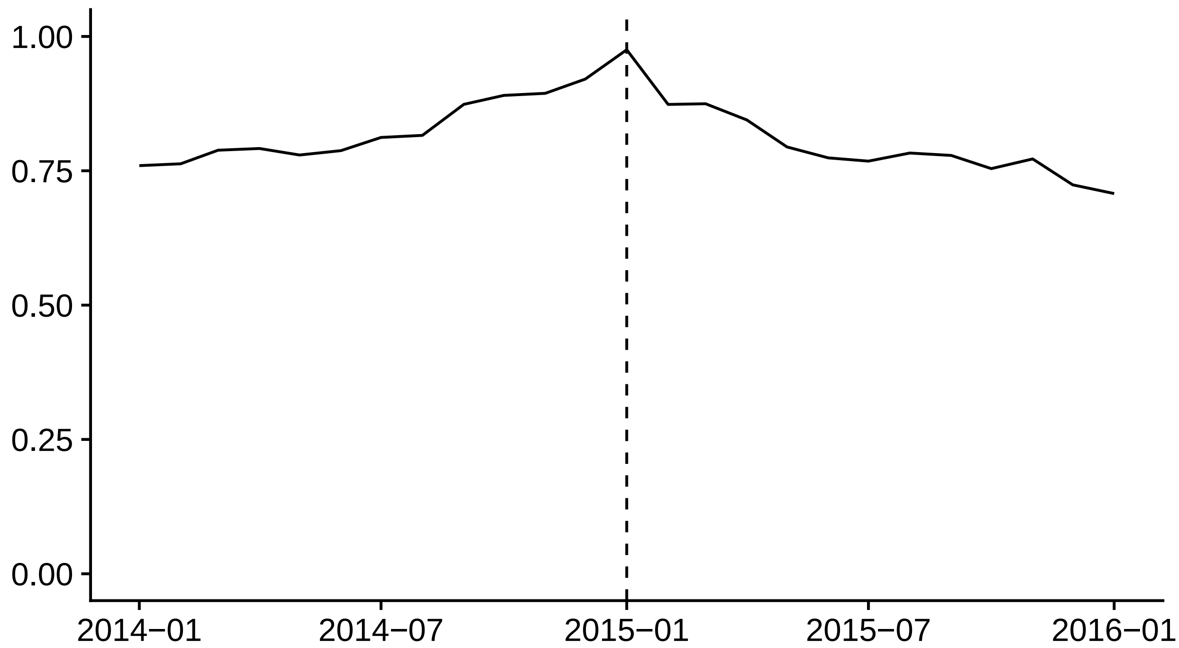
Note: The figure plots estimated delta coefficients from equation 1. Panel A depicts results from regressions with log of total non−durable expenditure as the dependent variable. Panel B represents results with log of essentials expenditure (groceries, energy, public transportation, gasoline) as dependent variable. For each dependent variable I estimate equation 1 separately for households who are liquidity constrained before offer announcement and for unconstrained households. Applicant households include those who apply for a 12−month flexibility policy so that time from the start of the flexibility policy is the same for all applicants. I remove monthly variation in consumption by using matched non−applicants as controls. I use propensity score matching within a particular household structure, age bin, urbanization category, employee status, and liquidity constraint dummy. Period 0 refers to the last month of the flexibility policy. Vertical bars represent 95 percent confidence intervals.

Figure A.1: Event study: liquidity-constrained applicants do not smooth consumption at the end of flexibility (matched sample)



Note: The figure plots average consumption per period relative to average consumption in the last period of the 12−month flexibility policy using simulations from the inertia model for different values for the long−run discount factor delta. I calculate the average consumption path among households who are liquidity constrained before the offer in January 2015. I compare the model predictions to reduced−form estimates from the event−study regression for households who are liquidity constrained before the offer. The reduced−form estimates include 95 percent confidence intervals.

Figure A.2: Consumption smoothing at the end of flexibility for impatient households without self-control problems



Note: The figure plots the persistence of liquidity constraints among households classified as liquidity constrained in the baseline month of January 2015 who do not apply for flexibility. The y−axis measures the share of households satisfying the liquidity constraint criteria in each month. The value is 1 in January 2015 by construction.

Figure A.3: Liquidity constraints are persistent among non-applicants

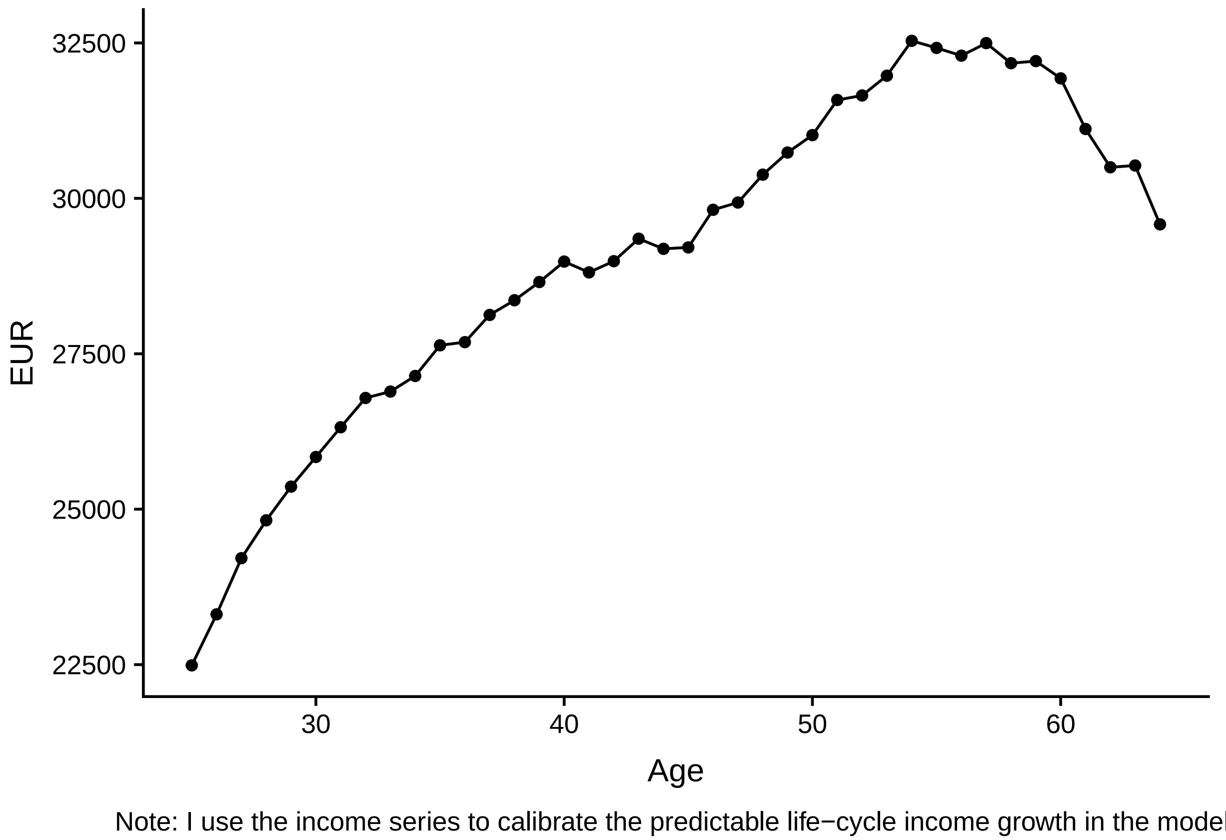


Figure A.4: Equivalized disposable income series underlying permanent income growth (Statistics Finland, 2014 data)

Table A.1: Benefits of flexibility are larger for households who apply

Model	Apply	N	Mean	Std. dev.	Q0.05	Q0.25	Median	Q0.75	Q0.95
Inertia	No	758	1,387	1,564	5	165	1,122	2,084	3,722
Inertia	Yes	242	1,905	1,788	29	642	1,812	2,766	4,182
Commitment	No	758	1,097	3,232	-180	18	228	764	4,871
Commitment	Yes	242	1,756	4,324	-174	80	446	1,174	10,021

[a] The table presents key statistics on the distribution of the benefits of flexibility by true application decision for the sample of 1,000 households for whom I solve the commitment and inertia models.

[b] The measure of benefits is the amount of liquid assets in EUR that the household would give up to keep flexibility instead of needing to make positive minimum amortization payments.

Table A.2: Event study: liquidity-constrained applicants do not smooth consumption at the end of flexibility (matched sample)

	Dependent variable:			
	Total non-durables	Total non-durables	Essentials	Essentials
	(1)	(2)	(3)	(4)
9th flexibility month	−0.007	−0.011	−0.005	−0.006
	(0.004)	(0.007)	(0.005)	(0.008)
10th flexibility month	−0.005	0.0001	−0.002	0.004
	(0.004)	(0.007)	(0.005)	(0.007)
11th flexibility month	−0.006	−0.002	−0.005	−0.001
	(0.004)	(0.007)	(0.005)	(0.007)
1st amortization month	−0.005	−0.027***	−0.002	−0.024***
	(0.004)	(0.007)	(0.005)	(0.007)
2nd amortization month	−0.018***	−0.048***	−0.014***	−0.044***
	(0.004)	(0.007)	(0.005)	(0.007)
3rd amortization month	−0.012***	−0.046***	−0.007	−0.047***
	(0.004)	(0.007)	(0.005)	(0.008)
4th amortization month	−0.018***	−0.053***	−0.015***	−0.048***
	(0.004)	(0.007)	(0.005)	(0.008)
5th amortization month	−0.018***	−0.066***	−0.011**	−0.063***
	(0.004)	(0.007)	(0.005)	(0.008)
Household sample	Unconstrained	Constrained	Unconstrained	Constrained
N(Applicants)	16,712	8,293	16,708	8,293

Note: *p<0.1; **p<0.05; ***p<0.01

The table presents estimates of the delta coefficients in equation 1. The omitted baseline month is the last flexibility month. Models 1 and 2 use the log of total non-durable expenditure as the dependent variable. Models 3 and 4 present results with log of essentials expenditure (groceries, energy, public transportation, gasoline) as the dependent variable. Standard errors clustered by household in parentheses. For each dependent variable I estimate equation 1 separately for households who are liquidity constrained before offer announcement and for unconstrained households. Applicant households include those who apply for a 12-month flexibility policy. I remove monthly variation in consumption by using matched non-applicants as controls. I use propensity score matching within a particular household structure, age bin, urbanization category, employee status, and liquidity constraint dummy. The results are presented graphically in Figure A.1.

Table A.3: Benefits of flexibility are large for impatient households without self-control problems

Model	δ	N	Mean	Std. dev.	Q0.05	Q0.25	Median	Q0.75	Q0.95
Inertia	0.7	1,000	6,540	3,393	1,917	4,053	6,157	8,647	12,284
Inertia	0.8	1,000	5,878	3,242	1,373	3,526	5,377	7,916	11,483
Inertia	0.9	1,000	4,280	2,720	416	2,297	3,871	5,914	9,055
Inertia	0.97	1,000	1,512	1,635	6	246	1,265	2,288	3,918

[a] The table presents key statistics on the distribution of the benefits of flexibility in the inertia model without self-control problems with different values for the long-term discount factor delta.

[b] The measure of benefits is the amount of liquid assets in EUR that the household would give up to keep flexibility instead of needing to make positive minimum amortization payments.

Table A.4: Benefits of flexibility in the inertia model with high steady-state interest rates

Model	N	Mean	Std. dev.	Q0.05	Q0.25	Median	Q0.75	Q0.95
Steady-state nominal rate at 6 percent								
Inertia	1,000	1,175	3,718	4	22	171	991	4,355
Steady-state nominal rate at 3.5 percent								
Inertia	1,000	1,512	1,635	6	246	1,265	2,288	3,918
Commitment	1,000	1,256	3,536	-174	23	268	879	6,368

[a] The table compares the benefits of flexibility in the inertia model with high steady-state nominal interest rates to benefits from the inertia and commitment models with steady-state interest rates at the pre-crisis average (January 1999–August 2008). The total mortgage interest rate is the steady-state rate + household-specific mortgage margin.

[b] The measure of benefits is the amount of liquid assets in EUR that the household would give up to keep flexibility instead of needing to make positive minimum amortization payments.