

A Quantitative Model of High-Cost Consumer Credit

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Introduction

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 - APR of 322%
 - loan size \$350
 - maturity of 14 days
 - 80% of loans are renewed

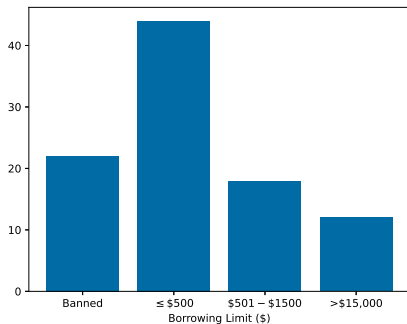
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 - APR of 322%
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 - 80% of loans are renewed
- Payday borrowers are mostly low income, low net-worth, in particular, low liquidity, most lack access to credit card debt (SCF, 2016; Bhutta, Skiba, Tobacman, 2015)

Motivation

- Widespread regulation at the state-level: bans, borrowing limits, interest rate caps

Figure: Fraction of states per payday borrowing limit



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- Policy: preserve access to credit vs restrict borrowing
- **Key takeaway:** financial frictions already taking care of overborrowing by temptation households

- **Quantitative Unsecured Credit:** Chatterjee, Corbae, Nakajima, Rios-Rull (2007), Livshits, MacGee and Tertilt (2007), Athreya, Tam, and Young (2012), Nakajima (2017)

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- **Empirical Payday Lending:** E.g., Zinman (2010), Carvalho, Olafsson and Silverman (2019)

Temptation and Self Control

Two-period model

- $T = 2$, endowment economy, no uncertainty, fixed R
- Gul and Pesendorfer (2001), Krusell, Kuruscu and Smith (2009)

$$\max_{c_1, c_2, a_2} \underbrace{u(c_1) + \beta u(c_2)}_{\text{Commitment utility}} + \gamma \underbrace{[u(c_1) + \delta \beta u(c_2)]}_{\text{Temptation utility}} \quad (1)$$

$$- \gamma \underbrace{\max_{\tilde{c}_1, \tilde{c}_2, \tilde{a}_2} u(\tilde{c}_1) + \delta \beta u(\tilde{c}_2)}_{\text{Maximal temptation}} \quad (2)$$

subject to:

$$c_1 = y - \frac{1}{R} a_2 \quad \tilde{c}_1 = y - \frac{1}{R} \tilde{a}_2 \quad (3)$$

$$c_2 = y + a_2 \quad \tilde{c}_2 = y + \tilde{a}_2 \quad (4)$$

$$\bar{a} \leq a_2, \tilde{a}_2 \quad (5)$$

Temptation and Self Control

Two-period model, optimal \bar{a}

- $\delta < 1$: $\tilde{a}_2^* < a_2^* \leq a_2^c$

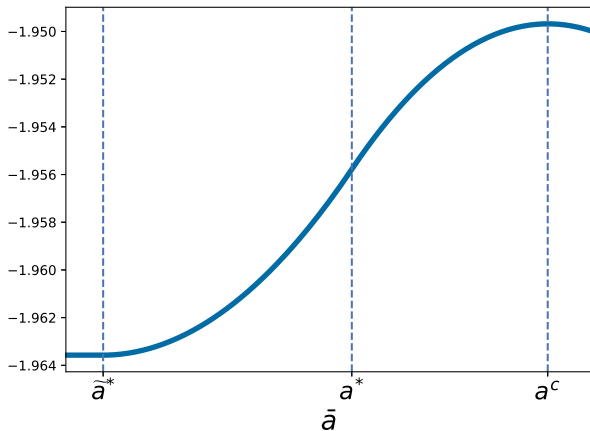


Figure: Welfare: optimal \bar{a}

Temptation and Self Control

Two-period model, with default

- Now, with uncertainty in the second period:

$$y_2 = \begin{cases} y_h, & \text{w/ prob. } \pi \\ y_l, & \text{w/ prob. } 1 - \pi \end{cases} \quad (6)$$

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- And, allow for default:

$$U = \max_{a_2} (1 + \gamma) u(y_1 - q(a_2)a_2) + (1 + \gamma\delta) \beta \mathbb{E} \max_{y_2 d \in \{0,1\}} \{u(y_2 - a_2), u(y_2) - \lambda\} - \tilde{U} \quad (7)$$

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- Free entry lenders: $q(a_2) = 1 - \mathbb{E}[d(a_2)]$

Temptation and Self Control

With default, optimal \bar{a}

- Optimal \bar{a} depends on the cost of default λ

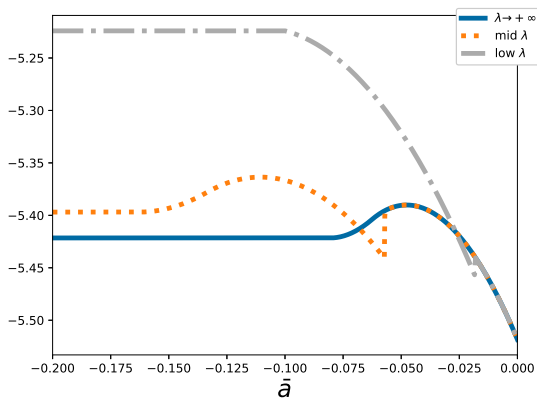


Figure: Welfare: optimal \bar{a}

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Quantitative Model

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- Uninsurable idiosyncratic risk in income and expenditures
- Types of households: patient, impatient, self control and temptation
- Prices reflect the risk of default

Borrowing behavior:

Table: Borrowing moments

Average Loan (\$)	404
Fraction loans = \$500	55.8
Fraction loans \$100 - \$450	43.7
Average Sequence (months)	4.1
Sequences > 12 months	7.7
Sequences = 1 month	41.0
Default Rate short seqs.	16.0
Default Rate long seqs.	38.0
Fraction of payday borrowers	4.8

- Moments frequently regulated (directly or indirectly)

Valuations of a No-Borrowing Incentive (NBI):

- Alcott, Kim, Taubinsky and Zinman (2020)
- NBI: \$100 in 3 months if no borrowing in next 2 months

Table: Valuations NBI

Average valuation of a NBI (\$)	52
Fraction of valuations \$100-\$160 (%)	16.0

Valuations

- Among households that borrower in model: 1/3 has temptation issues; 2/3 are patient or impatient
 - Consistent with qualitative survey data for high-cost borrowers (CFPB, 2012)

- In the estimated model for the US, borrowing limits and interest rate ceilings reduce the welfare for newborns that suffer from temptation and self-control
 - Banning payday lending: **-0.02% of consumption**

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 - Banning payday lending: **-0.02% of consumption**
- Welfare gains and losses across income levels among households with temptation issues
 - Banning payday lending: range **between -0.20% and 0.03% of consumption**

Conclusion

- High-cost lending, in particular payday lending, is heavily regulated in the US
- I study the trade-off insurance vs self-control to study optimal policy
- I develop a quantitative model of high cost consumer credit that features idiosyncratic risk, self control and temptation preferences together with risk-based pricing
- I find that among payday borrowers, 2/3 are exponential discounters (patient and impatient), and 1/3 have self-control and temptation issues
- I find welfare losses from borrowing limits and interest rate caps for newborns with temptation in the estimated model for the US

Expenditure risk

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$$\underline{c}' = \mu_c + \rho_c \underline{c} + \epsilon'_c, \quad \epsilon_c \sim N(0, \sigma_c^2) \quad (9)$$

- Trade-off disutility of shock vs cost of dissaving/borrowing

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- Trade-off disutility of shock vs cost of dissaving/borrowing
- Consistent with relative volatility of consumption and income, but low correlation of the two

Model

Households

- Households are type $i = P, I, T$, each with measure $(\omega_1, \omega_2, 1 - \omega_1 - \omega_2)$

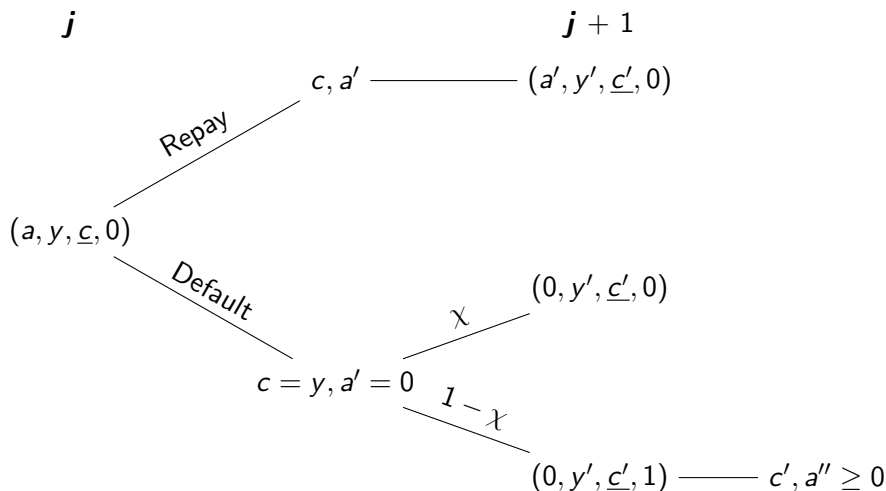
Model

Households

- Households are type $i = P, I, T$, each with measure $(\omega_1, \omega_2, 1 - \omega_1 - \omega_2)$
- State vector (a, y, \underline{c}, d) , age j
- $a = \text{savings/debt}$, $y = \text{income}$, $\underline{c} = \text{expenditure shock}$, $d = 1$ if excluded from borrowing; $d = 0$ otherwise

Quantitative Model

Households



Repay

Default

Quantitative Model

Lenders

- Zero profit condition:

$$q_j^i(a', y, \underline{c}) = \frac{1}{1+r} \left[1 - E[d_{j+1}^i(a', e', \underline{c}')] - \kappa \right] \quad (10)$$

- Operational costs (wages, advertising and occupational costs) are significant in payday lending
- r is fixed

- Income and expenditure shocks from Young, Miranda-Pinto, Walsh, Murphy (2020)

Estimation

Strategy

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 - Exogenous borrowing limit: \$500
 - Interest rate cap: interest rates $< \frac{10\%(Loan)+\$5}{Loan}$

Estimation

Strategy

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- Operational costs κ to match 10% monthly interest rate
- Current regulation
 - Exogenous borrowing limit: \$500
 - Interest rate cap: interest rates $< \frac{10\%(Loan)+\$5}{Loan}$
- Estimate remaining parameters

Estimation

Jointly determined parameters

10 parameters, 11 moments

- Discount factors: $\beta_P, \beta_I, \beta_T$
- Temptation: δ, γ
- Household type weights: ω_1, ω_2
- Default cost: λ
- Expenditure shock utility cost: η
- Exclusion from borrowing: χ

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 - whether there was a payment and when
 - date of birth and zip code of client
- Using date of birth and zip code of client, I define a sequence of loans as consecutive loans separated by less than 30 days

Results

Estimated Parameters

Table: Estimated parameters

Parameters		Description
β_P	0.99	Discount Factor P
ω_1	0.94	Weight β_P
β_I	0.15	Discount Factor I
ω_2	0.034	Weight β_I
β_T	0.55	Discount Factor T
δ	0.17	Nature of temptation
γ	105.2	Strength of temptation
λ	0.15	Default utility cost
η	314	Exp shock utility cost
χ	0.05	Re-access probability

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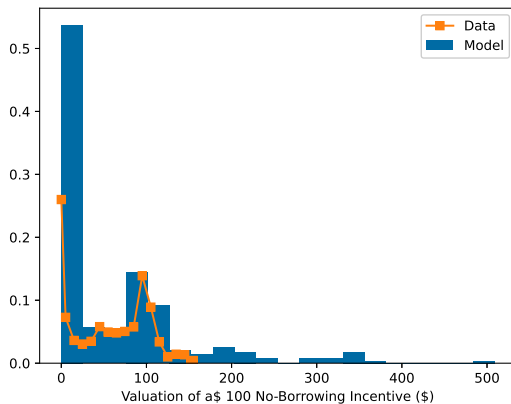
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Figure: Valuations NBI: model and data



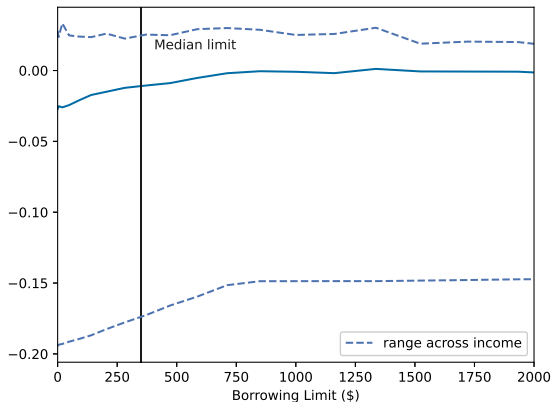
- Composition of borrowers between exponential discounters and temptation is consistent with qualitative data on self-control
NFWBS
- Model is consistent with actual policy reforms: the Oregon interest rate cap
 - Zinman (2010) estimates the effect of the cap on the likelihood of re-borrowing 3 months after policy change
 - The likelihood of continued borrowing drops 28 pp as a consequence of the cap; the model predicts a drop of 31 pp

- Regulatory borrowing limit: $a' \geq \bar{a}$
- Interest rate cap: $q > \frac{1}{1+\bar{r}}$

Policy Experiments

Borrowing limit

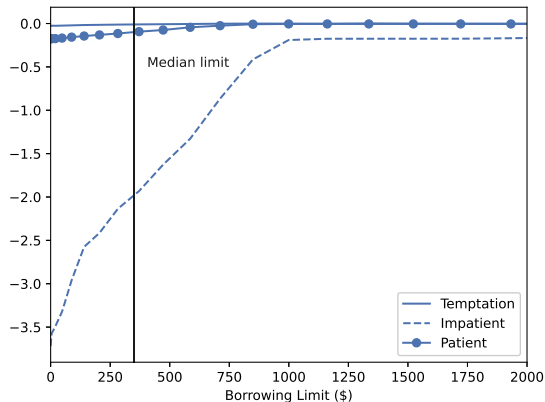
Figure: Welfare gains (%), newborns, temptation household



Policy Experiments

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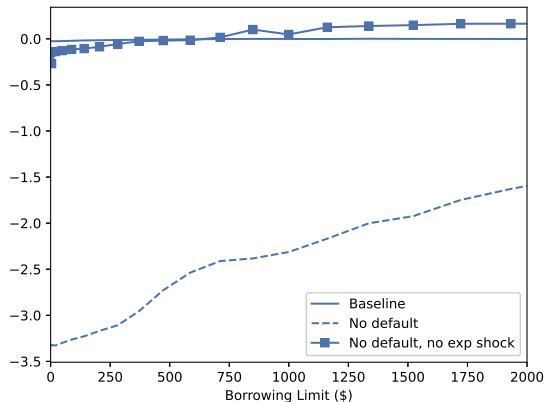
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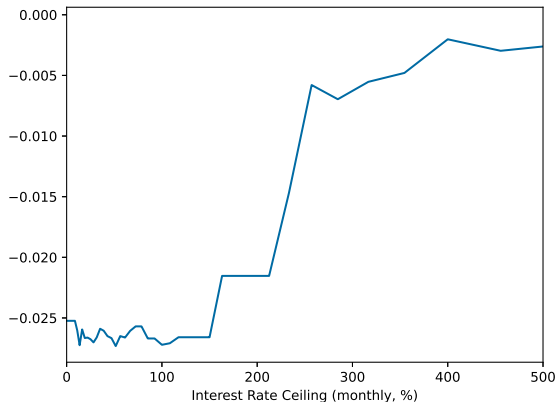
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Policy Experiments

Interest rate ceiling

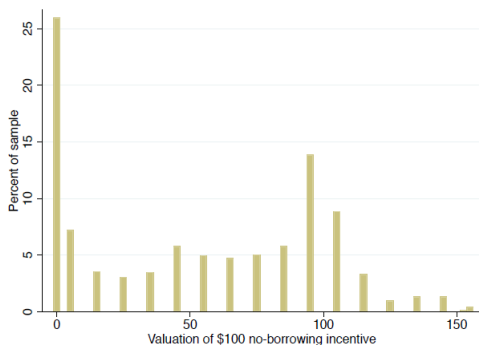
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Figure A2: Distribution of Valuations of the No-Borrowing Incentive

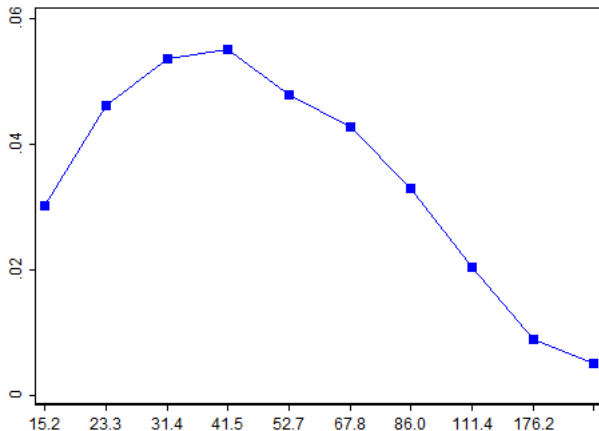


Notes: This figure presents the distribution of valuations of the \$100 no-borrowing incentive, as revealed on a multiple price list.

Figure: Distribution of valuations No Borrowing Incentive

Payday borrowing and income distribution

Figure: Fraction of households taking payday loans and income deciles (Ths. \$, SCF, 2016)



Income risk

- During working age: $y = x + z$ (Young, Miranda-Pinto, Walsh, Murphy (2020))

$$x' = \rho_x x + \sigma_x \epsilon'_x, \quad \epsilon_x \sim N(0, \sigma_x^2) \quad (11)$$

$$z' = \rho_z z + \sigma_z \epsilon'_z, \quad \epsilon_z \sim N(0, \sigma_z^2) \quad (12)$$

- ϵ_x, ϵ_z iid

Back

Results

Fit

Table: Joint estimation: data vs model

	Data	Model
Average Sequence (months)	4.2	5.1
Sequences > 12 months	7.7	8.0
Sequences = 1 months	41.0	26.7
Average Loan (\$)	404	260
Fraction loans = \$500	55.8	37.4
Fraction loans \$100 - \$450	43.68	21.5
Default rate long seq.	38.0	29.0
Default rate short seq.	16.0	17.9
Take-up rate	4.8	5.0
Average valuation NBI	52.0	58.8
Fraction of valuations between \$100-\$160	16.0	13.1

Regulation

Borrowing limit

Figure: Fraction of states per payday borrowing limit

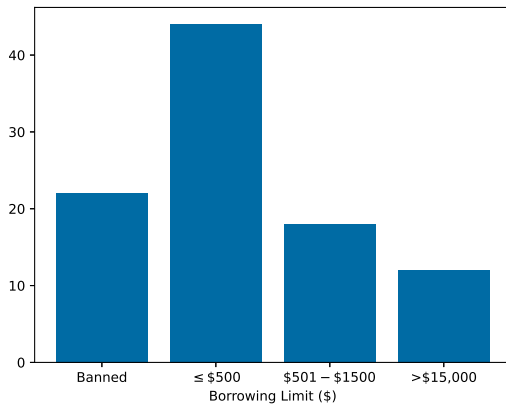
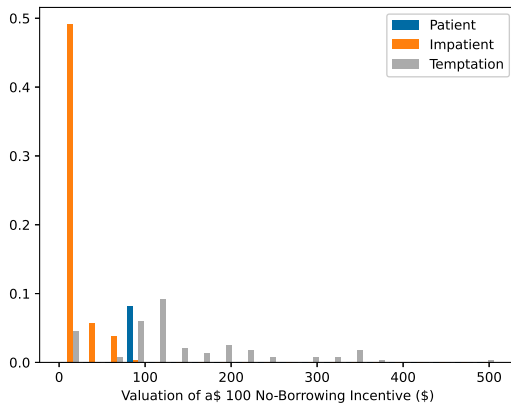


Figure: Fraction of borrowers by type of agent



- Households are type $i = P, I, T$, each with measure $(\omega_1, \omega_2, 1 - \omega_1 - \omega_2)$ and state vector (a, y, \underline{c}, d)

Model

Households

- Households are type $i = P, I, T$, each with measure $(\omega_1, \omega_2, 1 - \omega_1 - \omega_2)$ and state vector (a, y, \underline{c}, d)
- $d = 1$ if excluded from borrowing; $d = 0$ otherwise

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- $d = 1$ if excluded from borrowing; $d = 0$ otherwise
- Households can repay or default each period:

$$v_j^i(a, y, \underline{c}, 0) = \max \left\{ v_j^{i,s}(a, y, \underline{c}), v_j^{i,d}(a, y, \underline{c}) \right\}, \quad i = P, I, T \quad (13)$$

$$d_j^i(a, y, \underline{c}) = \mathbb{1} \{ v_j^{i,s} < v_j^{i,d} \} \quad (14)$$

Temptation: $i = T$

- If they repay:

$$v_j^{T,s}(a, y, \underline{c}) = \max_{c, a'} \left\{ (1 + \gamma) [u(c) - \eta \max(\underline{c} - c, 0)] \right. \\ \left. + (1 + \delta\gamma)\beta^T \mathbb{E}_{y', \underline{c}' | y, \underline{c}} \left[v_{j+1}^T(a', y', \underline{c}', 0) \right] \right\} - \tilde{v}_j(a, y, \underline{c}, 0) \quad (15)$$

$$\text{s.t. } c = a + y - q_j^T(a', y, \underline{c}) a'$$

Back

Temptation:

- If they default:

$$\begin{aligned}
 v_j^{T,d}(a, y, \underline{c}) = & (1 + \gamma) [u(y) - \eta \max(\underline{c} - y, 0) - \lambda] \\
 & + (1 + \delta\gamma)\beta^T \mathbb{E}_{y', \underline{c}', d' | y, \underline{c}} \left[v_{j+1}^T(a', y', \underline{c}', d') \right] \\
 & - \tilde{v}_j(a, y, \underline{c}, 0)
 \end{aligned} \tag{16}$$

Back

Maximal temptation:

$$\tilde{v}_j(a, y, \underline{c}, 0) = \max \left\{ \tilde{v}_j^s(a, y, \underline{c}), \tilde{v}_j^d(a, y, \underline{c}) \right\} \quad (17)$$

Maximal temptation:

- If they repay:

$$\begin{aligned} \tilde{v}_j^s(a, y, \underline{c}) = & \gamma \max_{\tilde{c}, \tilde{a}'} \left\{ u(\tilde{c}) - \eta \max(\underline{c} - \tilde{c}, 0) \right. \\ & \left. + \delta \beta^T \mathbb{E}_{y', \underline{c}' | y, \underline{c}} [v_{j+1}^i(\tilde{a}', y', \underline{c}', 0)] \right\} \quad (18) \\ \text{s.t. } & \tilde{c} = a + y - q_j^T(\tilde{a}', y, \underline{c}) \tilde{a}' \end{aligned}$$

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- If they default:

$$\begin{aligned} \tilde{v}_j^d(a, y, \underline{c}) = & \gamma \left\{ u(y) - \eta \max(\underline{c} - y, 0) - \lambda \right. \\ & \left. + \delta \beta^T \mathbb{E}_{y', \underline{c}', d' | y, \underline{c}} [v_{j+1}^i(0, y', \underline{c}', d')] \right\} \quad (19) \end{aligned}$$

When excluded:

- Cannot borrow with probability χ , but they can save

Results

Identification ω_2

- Composition of borrower preferences consistent with qualitative survey data on self-control

Table: Fractions of high-cost borrowers that answer "Completely well" or "Very well" to self-control statements in National Financial Well-Being Survey (CFPB)

Data	
I am able to work diligently toward long-term goals	69.9
I am good at resisting temptation	61.1
Model	
$\omega_P + \omega_I$	64.3
ω_T	35.7

Temptation and Self Control

With default

• $\lambda \rightarrow \infty$

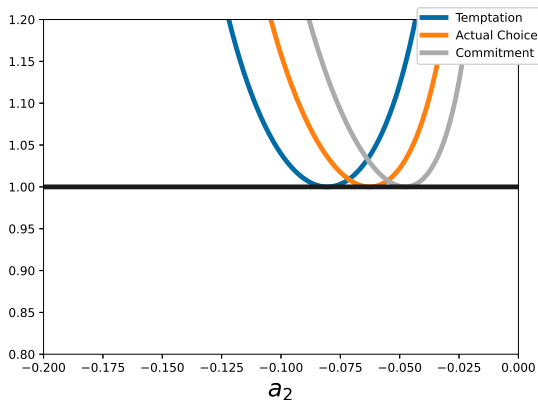


Figure: Indifference curve: q, a_2

Temptation and Self Control

With default

- Mid λ

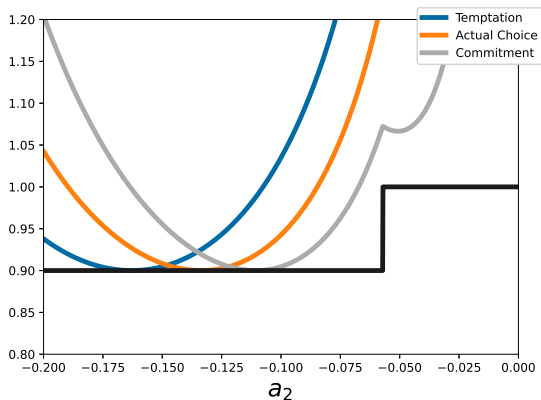


Figure: Indifference curves and debt price: medium λ

Temptation and Self Control

With default

- Low λ

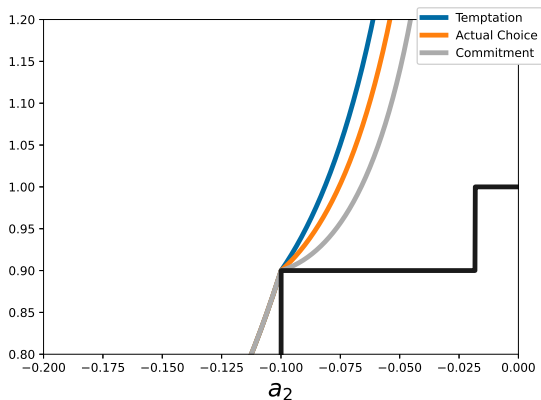


Figure: Indifference curves and debt price: low λ