# The Term Structure of Debt Commitments, Liquidity Concerns, and Durable Good Choices

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# Motivation

- Explosion of interest in importance of liquidity constraints in macro models

  Moving away from permanent income hypothesis

- Study importance of liquidity constraints in an important asset category: auto loans
  - Auto loans good laboratory to study liquidity constraints
  - Auto borrowers tend to be lower-income and lower-asset

- Term length choice an important contract feature for auto loans

  Determines monthly payment, interest rate, speed of repayment, ...

- Key facts: term lengths are heterogeneous and rising

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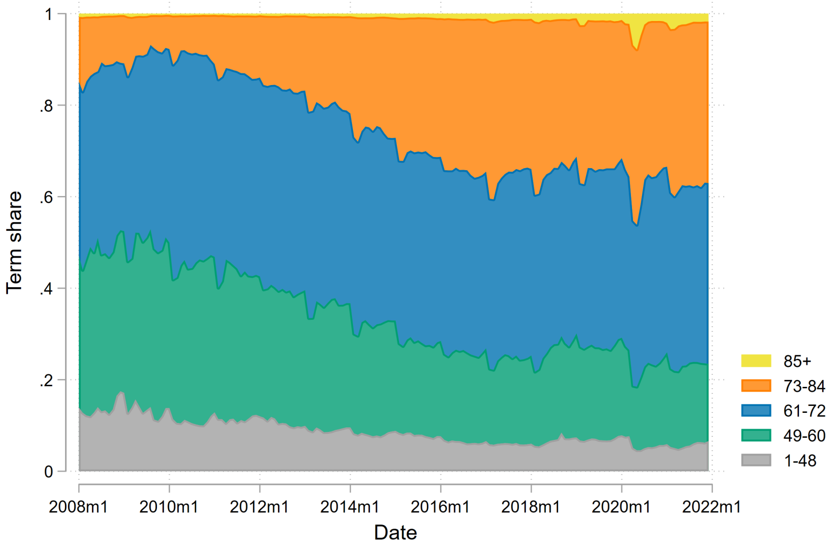
  Determines monthly payment, interest rate, speed of repayment, ...

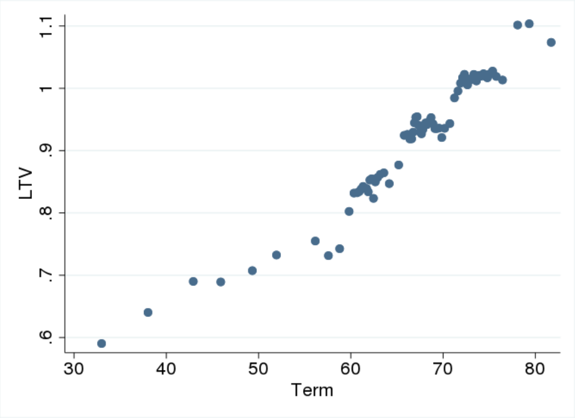
- Key facts: term lengths are heterogeneous and rising

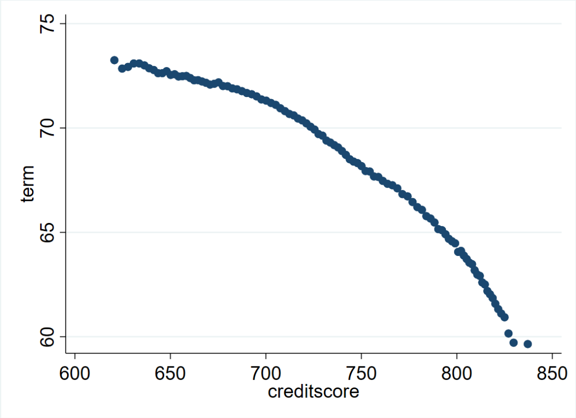
**How do liquidity considerations impact term length choices?**

# Auto term lengths heterogeneous and rising

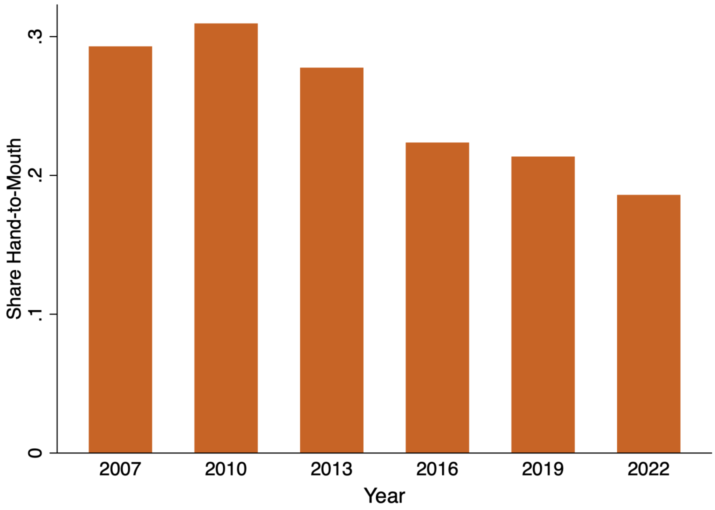


# Term lengths *seem* to be chosen by low-liquidity households

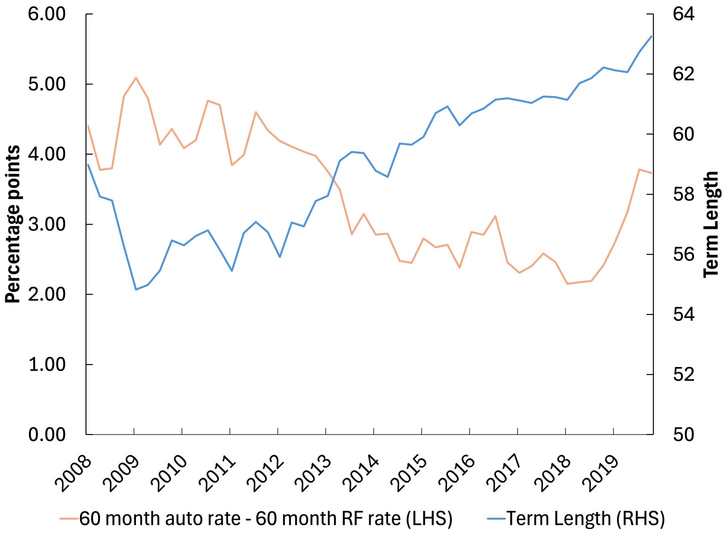


# Households *less* liquidity constrained over time



# Relative cost of borrowing over time



# This paper

- Empirical work:
  - Document causal relationship between liquidity and term length choice
  - Use consumer credit panel with liquidity measure and term length
  - IV strategy to get exogenous variation in liquidity measure

- Model work:
  - Simple and quantitative model of term length choice
  - Show importance of distance to liquidity constraint in determining term lengths

    Precautionary motive for choosing long term lengths
  - Distance to liquidity constraint interacts with relative cost of borrowing to determine term lengths

# Preview of Results

1. Document that cross-section variation of terms driven by liquidity
    - Novel empirical evidence showing causal effect of liquidity on term length choice
    - 1 sd increase in liquidity $\rightarrow$ 4 month decrease in term length
    - Model importance of heterogeneity in liquidity for term choice

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1. Document that cross-section variation of terms driven by liquidity
    - Novel empirical evidence showing causal effect of liquidity on term length choice
    - 1 sd increase in liquidity $\rightarrow$ 4 month decrease in term length
    - Model importance of heterogeneity in liquidity for term choice
2. Document that the time-series variation of terms driven by relative cost interacted with liquidity
    - Decrease in spread between borrowing and saving rates over time
    - Causes near-constrained households to increase term lengths

# Contributions to Literature

1. Term lengths in auto loans

   Attanasio et al. (2008), Hertzberg et al. (2018), An, Cordell & Tang (2020), Argyle et al. (2020), Guo, Zhang & Zhao (20220), Katcher et al. (2024)

   → **model term length choice from household perspective, find liquidity important driver of longer term lengths**

2. Liquidity constraints and durable demand

   Mishkin (1976), Heitfield & Sabarwal (2004), Attanasio et al. (2008), Adams, Einav & Levin (2009), Mian & Sufi (2012), Benmelech et al. (2017), Gavazza and Lanteri (2021)

   → **Link liquidity constraints and term length choice for autos**

3. Models of durable goods demand

   Grossman and Laroque (1990), Caballero (1993), Eberly (1994), Kaplan and Violante (2014), Berger and Vavra (2015), Guerrieri and Lorenzoni (2017), Gavazza and Lanteri (2021), McKay & Wieland (2021), Berger et al. (2023), Beraja & Zorzi (2024)

   → **Quantitative model of auto demand with term length choice**

# Outline

1. Background & Stylized Facts
2. Data & Empirical Strategy
3. Results
4. Simple Model
5. Quantitative Model
6. Conclusion

# Background & Stylized Facts

# Background

- Car financing contracts are simple-interest installment loans

- Schedule of term-lengths and interest rates *conditional* on household characteristics

  Relevant characteristics include: car value, down payment size, FICO score, income

- Households pay *fixed* monthly payments ($M$) to the lender which satisfy the following:

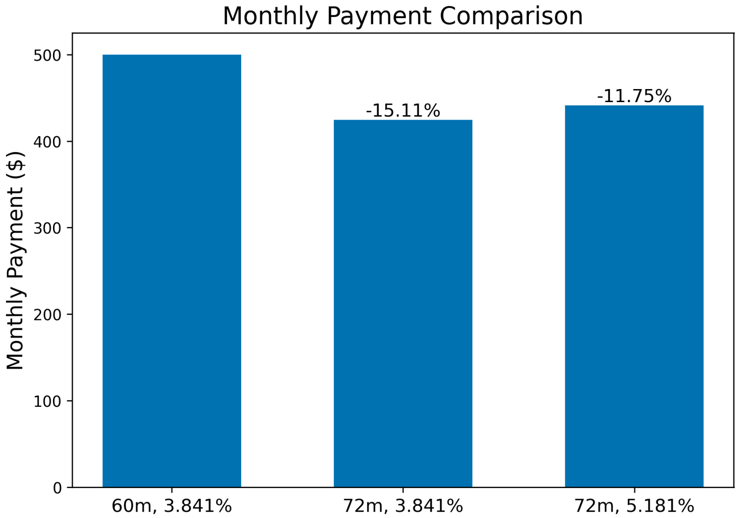
$$P = \frac{M}{(1+i)} + \frac{M}{(1+i)^2} + \cdots + \frac{M}{(1+i)^T}$$

  $P$ is the principal amount borrowed, $i$ is the monthly interest rate, and $T$ is the term length in months

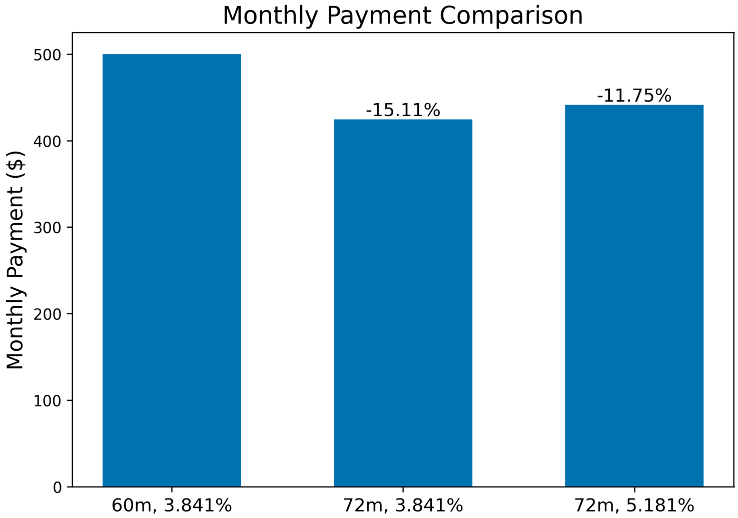
- Refinancing not common in auto loans

- No prepayment penalties

# Term lengths ease liquidity constraints: lower monthly payments

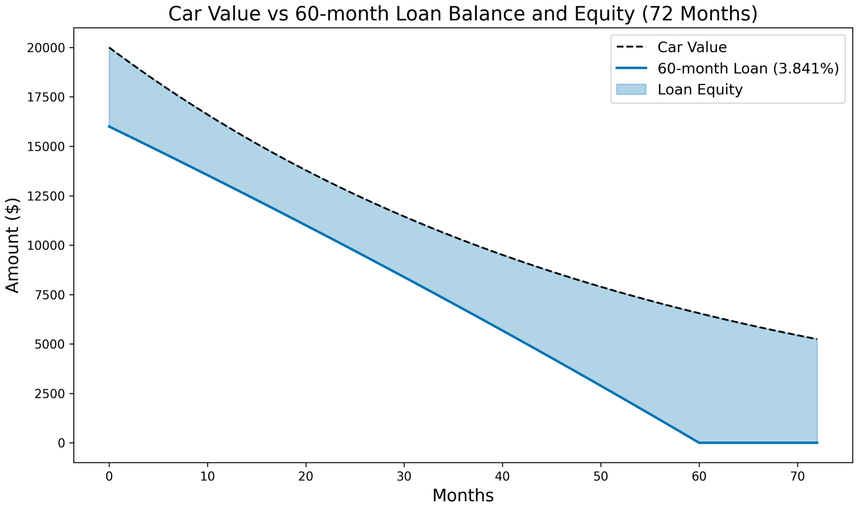


# Term lengths ease liquidity constraints: lower monthly payments



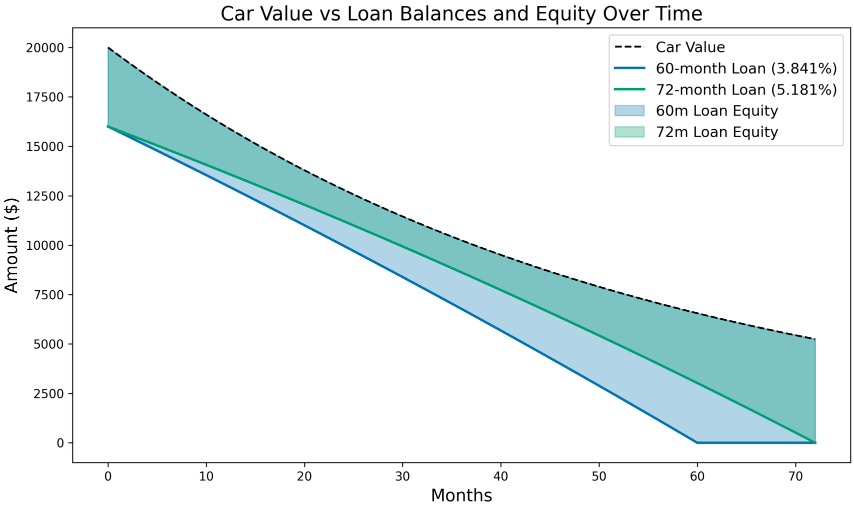

Benefit: increasing term length leads to lower monthly payments

# Term lengths ease liquidity constraints: pre-extracting liquidity



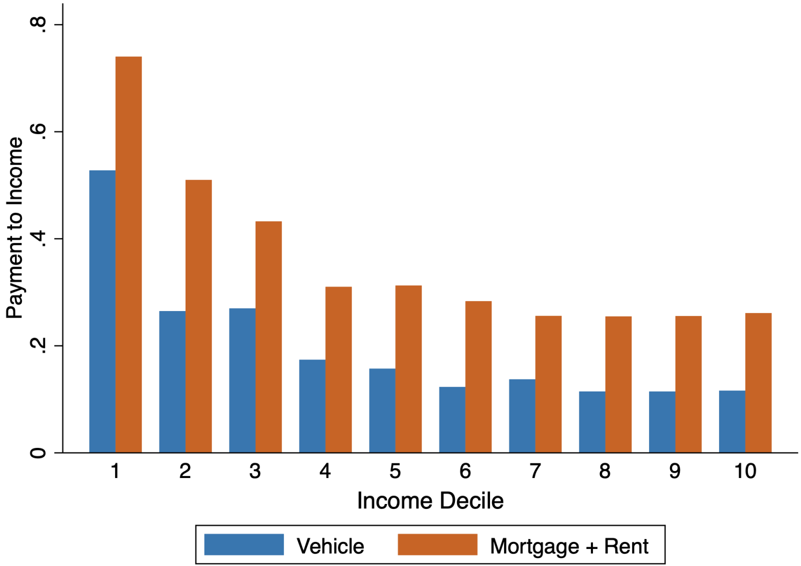

Households cannot extract equity without costly adjustment (no refi/HELOC)

# Term lengths ease liquidity constraints: pre-extracting liquidity

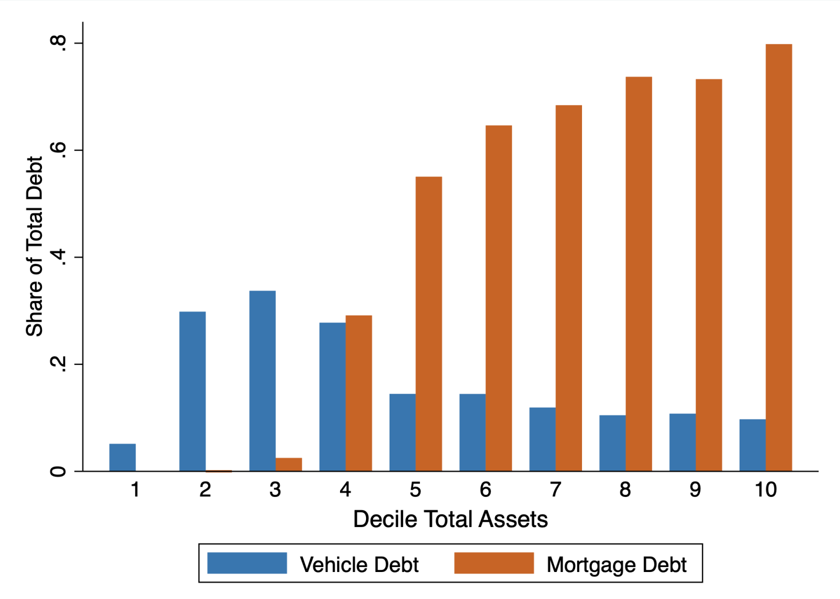



Increase term lengths pre-extracts liquidity

# Auto loan large commitment for borrowers



# Auto debt most important for low-asset households



# Term length: costs and benefits

- Benefits:
  - Lower monthly payments
  - Provides liquidity buffer for entire loan commitment
  - Particularly important:
    1. Cannot adjust liquidity without adjusting car/entire loan
    2. Car borrowing large commitment for households that tend to be lower-asset/income

# Term length: costs and benefits

- Benefits:
  - Lower monthly payments
  - Provides liquidity buffer for entire loan commitment
  - Particularly important:
    1. Cannot adjust liquidity without adjusting car/entire loan
    2. Car borrowing large commitment for households that tend to be lower-asset/income

- Costs:
  - Increase term length leads to a higher interest rate and overall larger total interest payment

**What is the causal relationship between liquidity and term length choice?**

# Data & Empirical Strategy

# Data

1. **NY Fed Equifax Consumer Credit Panel**
   - Anonymous quarterly credit panel
   - Includes share unused revolving credit (proxy for liquidity)
   - Term length of auto loans can be inferred from principal and monthly payment
   - Other details: risk score (not FICO score), age, zip-code/state, repayment history

2. **Zip Code Income**
   - IRS provides average income by zip code from tax returns from 2005 – 2021

▸ Summary Statistics

# Linking low liquidity and high terms

$$l_{it} = \alpha + \gamma_t + \beta b_{it} + \Gamma X_{it} + \epsilon_{it}$$

- $i$ is loan, $t$ is quarter
- $l_{it}$ is term length/indicator for term length above 60
- $b_{it}$ share revolving credit limit remaining (measure of liquidity)

  0 = fully constrained; 1 = fully unconstrained
- $X_{it}$ individual controls, such zip-code income, age, and state x time FEs

Hypothesis: high term lengths chosen by liquidity constrained $\rightarrow \beta < 0$

# Linking low liquidity and high terms

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Concern: OLS estimates biased towards zero

# Instrument for liquidity: age of oldest account

- Age of oldest credit account as instrument for liquidity

  Braxton et al. (2024)

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- Age of oldest credit account as instrument for liquidity

  Braxton et al. (2024)

- **Relevance** ($Cov(z_{it}, b_{it}) \neq 0$)
  - Automatic credit increases as a function of age
  - Credit agencies use age of oldest account as proxy for physical age

  $\rightarrow$ higher credit limit as function of age of account

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  $\rightarrow$ higher credit limit as function of age of account

- **Conditional exogeneity** ($Cov(z_{it}, \epsilon_{it} | b_{it}) = 0$)
  - Instruments increases credit score, could affect interest rates offered?

  $\rightarrow$ control for credit score as robustness

# Results

# Results: term length

| | OLS | OLS | IV | IV |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| % limit left | –2.939*** | | | |
| | (0.386) | | | |
| Observations | 307,906 | | | |
| Term mean | 62.49 | | | |
| Indep. var. sd. | 0.389 | | | |
| F-stat | – | | | |
| Credit group & type FE | No | | | |

*Notes:* *** $p<0.001$, ** $p<0.01$, * $p<0.05$. Source: Federal Reserve Bank of New York's Consumer Credit Panel/Equifax data (CCP) with author's calculations.

▸ First stage ▸ Additional results

# Results: term length

| | OLS | OLS | IV | IV |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| % limit left | –2.939*** | –1.625*** | | |
| | (0.386) | (0.302) | | |
| Observations | 307,906 | 306,165 | | |
| Term mean | 62.49 | 62.50 | | |
| Indep. var. sd. | 0.389 | 0.387 | | |
| F-stat | – | – | | |
| Credit group & type FE | No | Yes | | |

*Notes:* *** $p<0.001$, ** $p<0.01$, * $p<0.05$. Source: Federal Reserve Bank of New York's Consumer Credit Panel/Equifax data (CCP) with author's calculations.

First stage · Additional results

# Results: term length

| | OLS | OLS | IV | IV |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| % limit left | –2.939*** | –1.625*** | –8.262*** | |
| | (0.386) | (0.302) | (0.931) | |
| Observations | 307,906 | 306,165 | 307,906 | |
| Term mean | 62.49 | 62.50 | 62.49 | |
| Indep. var. sd. | 0.389 | 0.387 | 0.389 | |
| F-stat | – | – | 220.2 | |
| Credit group & type FE | No | Yes | No | |

*Notes:* *** $p<0.001$, ** $p<0.01$, * $p<0.05$. Source: Federal Reserve Bank of New York's Consumer Credit Panel/Equifax data (CCP) with author's calculations.

▸ First stage ▸ Additional results

# Results: term length

| | OLS | OLS | IV | IV |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| % limit left | –2.939*** | –1.625*** | –8.262*** | –12.51*** |
| | (0.386) | (0.302) | (0.931) | (1.925) |
| Observations | 307,906 | 306,165 | 307,906 | 306,165 |
| Term mean | 62.49 | 62.50 | 62.49 | 62.50 |
| Indep. var. sd. | 0.389 | 0.387 | 0.389 | 0.387 |
| F-stat | – | – | 220.2 | 126.4 |
| Credit group & type FE | No | Yes | No | Yes |

*Notes:* *** p<0.001, ** p<0.01, * p<0.05. Source: Federal Reserve Bank of New York's Consumer Credit Panel/Equifax data (CCP) with author's calculations.

**1 sd increase in % limit left $\rightarrow$ 4 month increase in term length**

▸ First stage ▸ Additional results

# Robustness

- Condition on positive percent limit left
- Alternate controls:
  - Different credit bins
  - Linear age (rather than age FEs)
  - Zipcode (rather than state) FEs
- Alternate independent measurement:
  - Use lagged percent limit left

▸ Results

# Simple Model

# Simple Model Set-Up

Demand/household:

- Face uninsurable income risk
- Inherit car debt $b_0$ and risk-free assets $a_0$
- Consume ($c_t$) and save ($a_{t+1}$) in each period of life
- Choose term length: modelled as permanent repayment speed ($\mu$)

  where $b_t = (1 - \mu) b_{t-1}$

Supply/lender:

- Offer interest rate schedule $r_b(\mu)$ on car debt

  where $r_b'(\mu) < 0$

# Why choose a longer term?

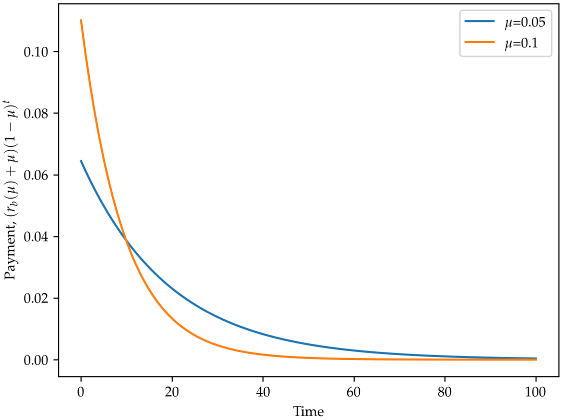
$$\max_{\mu, c_t, a_{t+1}} \sum_{t=0}^{\infty} \beta^t u(c_t)$$

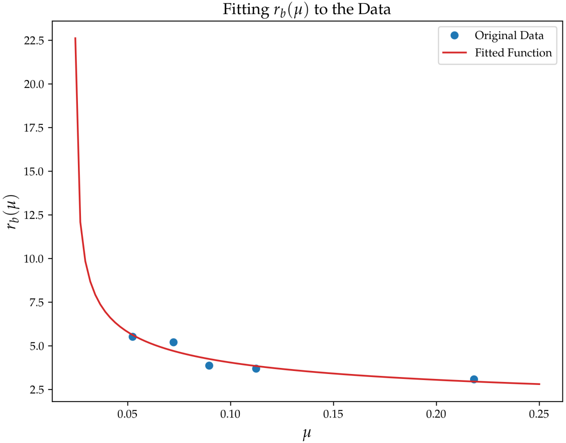
$$\begin{aligned}
\text{s.t.} \quad & c_t + a_{t+1} + (r_b(\mu) + \mu) b_t = y_t + (1 + r_a) a_t \\
& a_{t+1} \geq 0 \\
& b_{t+1} = (1 - \mu) b_t = (1 - \mu)^{t+1} b_0 \\
& y_t = \rho y_{t-1} + \epsilon_t
\end{aligned}$$

Benefit lower $\mu$: pay less in the short term via $(r_b(\mu) + \mu)$

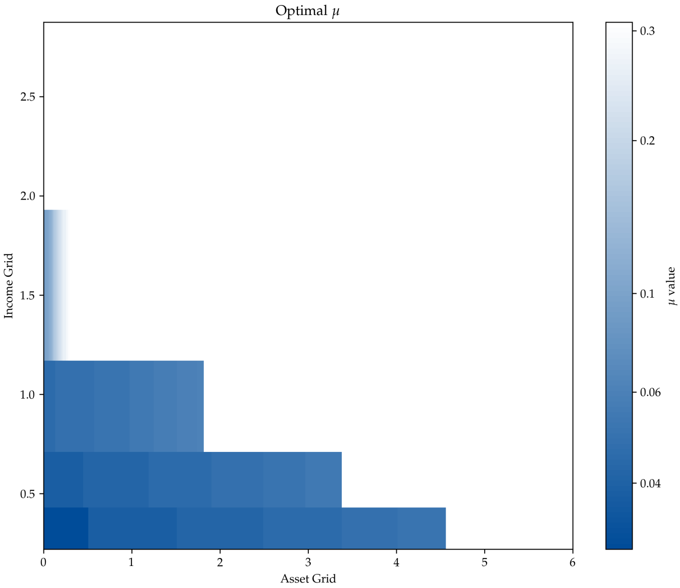
Cost lower $\mu$: higher interest rate $r_b(\mu)$ and pay more in the long term ($b_t = (1 - \mu)^t b_0$)

# Why choose a longer term

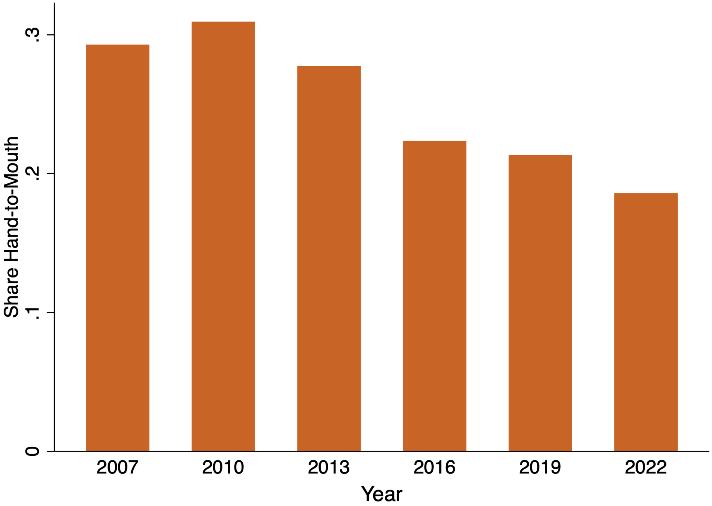


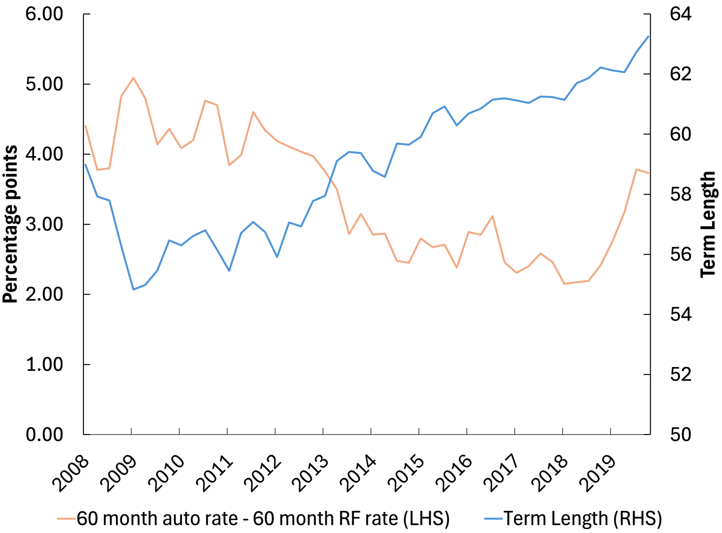
# Longer term lengths valued by low-liquidity households



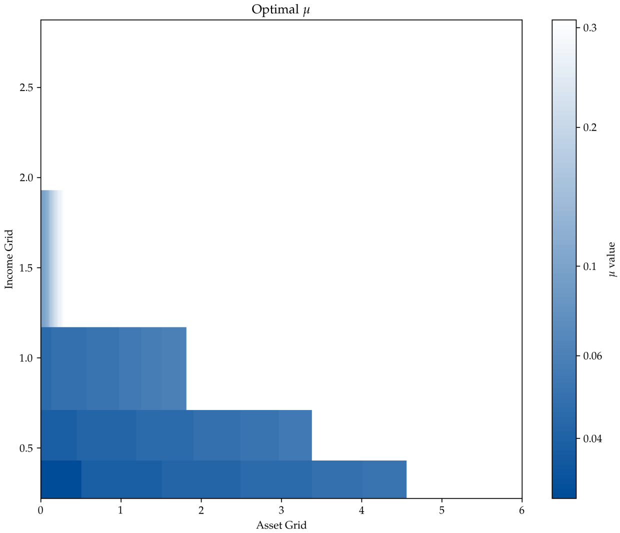
# Households *less* liquidity constrained over time



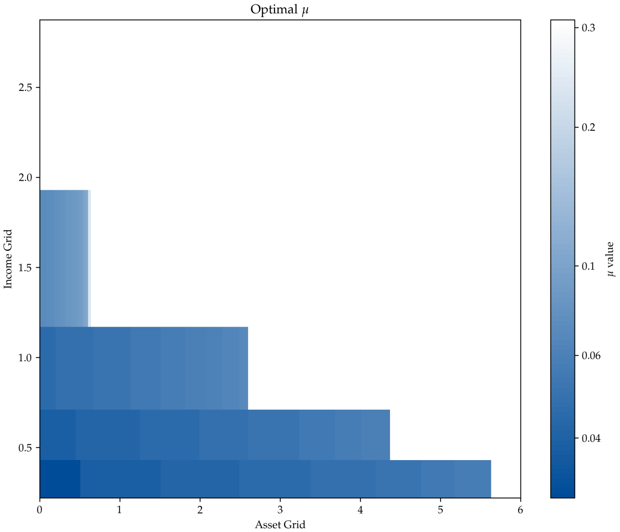
# Relative cost of borrowing over time



# Longer term lengths when $r_b(\mu) - r_a$ declines



# Longer term lengths when $r_b(\mu) - r_a$ *declines*




Response driven by near-constrained households

# Quantitative Model

# Model Set-Up

In addition to simple model set up...

- Households have two discrete choices:
  1. Durable/loan adjustment
  2. Term length ($\mu$)

- And four continuous choices:
  1. flexible consumption ($c$), risk-free assets ($a$), durable consumption ($d$), and durable loan ($b$)

# Non-adjusters' problem

$$
\begin{aligned}
V^{n-adj}(y,\mu,d,b,a) = \max_{c,a'} u(c,d') + \beta\mathbb{E}\left[V(y',\mu,d',b',a')|y\right] \\
\text{s.t. } c + a' + (\chi\delta p)d + \nu d' &= y + (1+r)a - (r^b(\mu)+\mu)b \\
a' &\geq 0 \\
d' &= (1-(1-\chi)\delta)d \\
b' &= (1-\mu)b \\
u(c,d') &= \frac{\left(c^\alpha d'^{1-\alpha}\right)^{1-\sigma}}{1-\sigma}
\end{aligned}
$$

# Adjusters' problem

$$V^{adj}_{\mu'}(y,d,b,a) = \max_{\{c,d',b',a'\}} u(c,d') + \beta\mathbb{E}\left[V(y',\mu',d',b',a')|y\right]$$

$$\begin{aligned}
\text{s.t. } & c + a' + (p+\nu)d' - b' = \\
& y + (1+r)a + (1-f)(1-\delta)pd - (1+r^b)b \\
& a' \geq 0 \\
& b' \in [0, \lambda pd] \\
& u(c,d') = \frac{\left(c^\alpha d'^{1-\alpha}\right)^{1-\sigma}}{1-\sigma}
\end{aligned}$$

# Discrete choices

1. Adjuster's $\mu$ choice:

$$V^{adj}(y,d,b,a) = \max\left\{V^{adj}_{\mu_1}(y,d,b,a) + \epsilon_{\mu_1}, V^{adj}_{\mu_2}(y,d,b,a) + \epsilon_{\mu_2}\right\}$$

2. Whether to adjust choice:

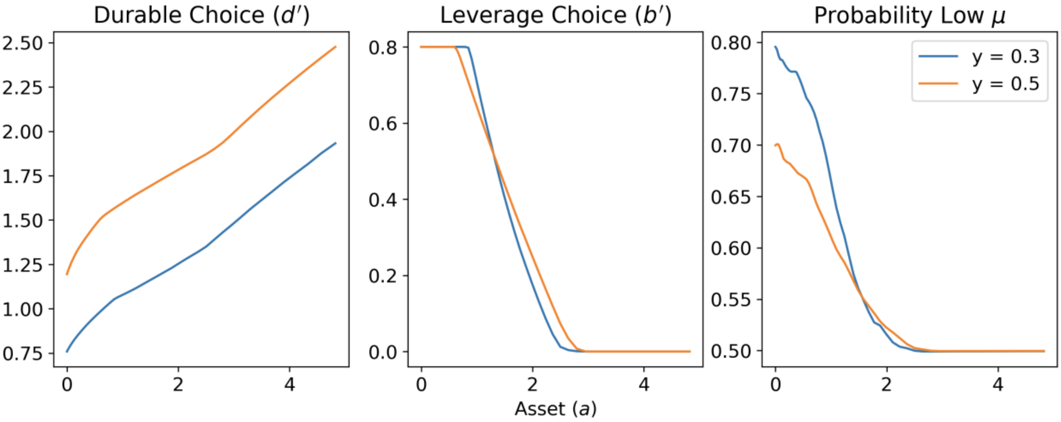
$$V(y,\mu,d,b,a) = \max\left\{V^{adj}(y,d,b,a) + \epsilon_{adj}, V^{n-adj}_{\mu_1}(y,\mu,d,b,a) + \epsilon_{nadj}\right\}$$

Where the $\epsilon_x$ represent taste shocks drawn from EV1 distributions

# Calibration targets

| Parameter | Explanation | Value | Source/Target |
|---|---|---|---|
| $\beta$ | Discount factor | 0.955 | Liq assets/Y $\approx$ 0.26 |
| $\alpha$ | Consumption weight in preferences | 0.725 | D spending/C $\approx$ 17% |
| $\kappa$ | Utility adjustment cost | 0.65 | Adj prob $\approx$ 0.296 |
| $\sigma^a$ | Adjustment taste shock scale | 0.08 | Relative MPX D v. C |
| $\sigma^\mu$ | Term choice taste shock scale | 0.5 | Low $\mu$ share $\approx$ 0.6 |
| $\sigma$ | Inverse EIS | 2 | Standard |
| $\lambda$ | LTV | 80% | Common for cars |
| $r$ | Interest rate | 1.05% | Avg. Fed Funds Rate |
| $\mu$ | Repayment speed | 7%, 20% | 5/7 year duration |
| $r_b$ | Interest rate on cars | 5.181%, 3.08% | Avg. spread on loan |

# Adjuster policy functions



## $r_b - r_a$ shock

- Shock $r_b - r_a$ by 1pp
- Leads to change in low $\mu$ share of households to change between 1–3pp
- Analogous to simple model, changes are driven by near-constrained rather than fully constrained households

# Conclusion

# Conclusion

1. Document that cross-section variation of terms driven by liquidity
   - Novel empirical evidence showing causal effect of liquidity on term length choice
   - 1 sd decrease in liquidity $\rightarrow$ 4 month decrease in term length
   - Model importance of heterogeneity in liquidity for term choice

2. Document that the time-series variation of terms driven by relative cost interacted with liquidity
   - Decrease in spread between borrowing and saving rates over time
   - Causes near-constrained households to increase term lengths
   - True in simple model, and robust to quantitative model which allows durable size choice

# Next Steps

1. Look at impact of liquidity considerations on other aspects of auto demand/contract (likelihood purchase, new/used, value purchase)

   Can use existing dataset to begin to address some of these

2. Look at impact of interest rate gap interacted with liquidity considerations empirically
3. Use quantitative model with term choice to evaluate how MP transmission impacted

Thank you!

# Appendix

# Summary Statistics

| | Obs. | Mean | St. Dev. |
|---|---|---|---|
| *Panel A: Individual characteristics* | | | |
| Age | 307,909 | 45.35 | 14.05 |
| AGI per tax return | n/a | $ 69.44 | $ 44.13 |
| Risk score (not Fico) | 307,909 | 704.88 | 88.67 |
| Ever bankrupt | 307,909 | 0.155 | 0.362 |
| Ever derogatory or bankrupt | 307,909 | 0.438 | 0.496 |
| *Panel B: Liquidity Characteristics* | | | |
| Percent limit left | 307,909 | 0.628 | 0.389 |
| Percent limit left (if ¿0) | 299,867 | 0.650 | 0.311 |

*Notes:* All dollar values are reported in 2017 dollars, and are reported in thousands.

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# Summary Statistics

| | Obs. | Mean | St. Dev. |
|---|---|---|---|
| *Panel C: Auto Loan Characteristics* | | | |
| Term length | 307,909 | 62.49 | 15.16 |
| Term length above 60 mos. | 307,909 | 0.602 | 0.489 |
| Interest rate (APR) | 307,909 | 0.067 | 3.35 |
| Initial balance | 307,909 | $ 23.97 | $ 13.01 |
| Monthly payment | 307,909 | $ 0.442 | $ 0.229 |

*Notes:* All dollar values are reported in 2017 dollars, and are reported in thousands.

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# Additional Results

| | *Independent variable:* Share limit remaining | | | |
|---|---|---|---|---|
| | OLS | OLS | IV | IV |
| | (1) | (2) | (3) | (4) |
| Term Length Above 60 | –0.114*** | –0.0519*** | –0.401*** | –0.310*** |
| | (0.0143) | (0.0091) | (0.0311) | (0.0610) |
| Observations | 307,906 | 306,165 | 307,906 | 306,165 |
| Term mean | 62.49 | 62.50 | 62.49 | 62.50 |
| Indep. var. sd. | 0.389 | 0.387 | 0.389 | 0.387 |
| F-stat (above 60) | – | – | 238.2 | 131.3 |
| Credit group & type FE | No | Yes | No | Yes |

*Notes:* *** $p<0.001$, ** $p<0.01$, * $p<0.05$. Source: Federal Reserve Bank of New York's Consumer Credit Panel/Equifax data (CCP) with author's calculations.

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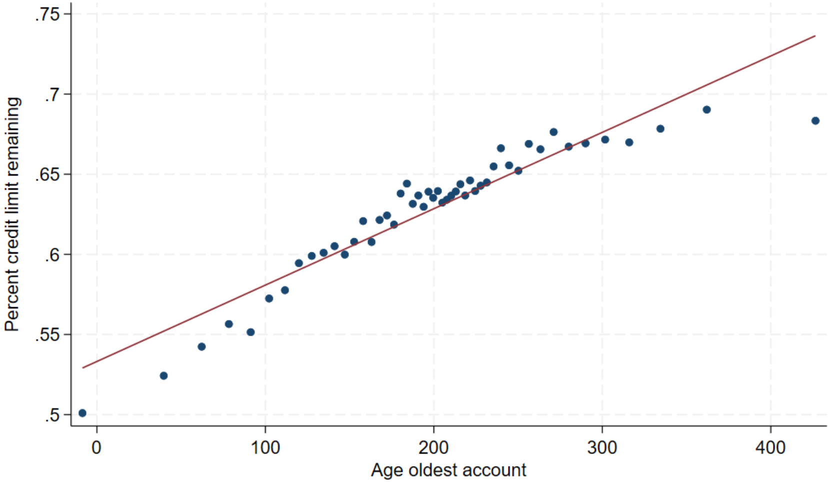
# First stage




Source: Federal Reserve Bank of New York's Consumer Credit Panel/Equifax data (CCP) with author's calculations.

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# First Stage

| | *Independent variable:* Age Oldest Account | |
|---|---|---|
| | (1) | (2) |
| Share Limit Left | 0.000477*** | -0.000218 *** |
| | (0.0000140) | (0.0000124) |
| Observations | 307,906 | 306,165 |
| Age sd. | 113.2 | 113.3 |
| Credit group & type FE | No | Yes |

*Notes:* *** $p<0.001$, ** $p<0.01$, * $p<0.05$. Source: Federal Reserve Bank of New York's Consumer Credit Panel/Equifax data (CCP) with author's calculations.

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# Robustness: Alternative Controls

| | *Independent variable:* Share limit remaining | | | |
|---|---|---|---|---|
| | OLS | OLS | IV | IV |
| | (1) | (2) | (3) | (4) |
| Term Length | −2.745*** | −1.404*** | −9.280*** | −12.30*** |
| | (0.339) | (0.229) | (0.974) | (2.116) |
| Observations | 276,477 | 274,610 | 276,477 | 274,610 |
| Term mean | 62.30 | 62.32 | 62.30 | 62.32 |
| F-stat (term length) | – | – | 227.7 | 140.3 |

*Notes:* *** $p<0.001$, ** $p<0.01$, * $p<0.05$. Source: Federal Reserve Bank of New York's Consumer Credit Panel/Equifax data (CCP) with author's calculations.

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# Robustness: Alternative Controls

| | *Independent variable:* Share limit remaining | | | |
|---|---|---|---|---|
| | OLS | OLS | IV | IV |
| | (1) | (2) | (3) | (4) |
| Term Length Above 60 | –0.109*** | –0.0477*** | –0.440*** | –0.313*** |
| | (0.0125) | (0.00727) | (0.0323) | (0.06664) |
| Observations | 276,477 | 274,610 | 276,477 | 274,610 |
| Term mean | 62.30 | 62.32 | 62.30 | 62.32 |
| F-stat (above 60) | – | – | 266.9 | 145.4 |

*Notes:* *** $p<0.001$, ** $p<0.01$, * $p<0.05$. Source: Federal Reserve Bank of New York's Consumer Credit Panel/Equifax data (CCP) with author's calculations.

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# Robustness: Lagged Limit Left

| | *Independent variable:* Lagged share limit remaining | | | |
|---|---|---|---|---|
| | OLS | OLS | IV | IV |
| | (1) | (2) | (3) | (4) |
| Term Length | −8.360*** | −11.70*** | −10.62*** | −9.359*** |
| | (0.953) | (0.876) | (1.525) | (0.990) |
| Observations | 307,909 | 299,864 | 298,311 | 276,480 |
| Term mean | 62.49 | 62.50 | 62.50 | 62.30 |
| Indep. var. sd. | 0.389 | 0.311 | 0.310 | 0.397 |
| F-stat (term length) | – | – | 414.7 | 223.6 |
| Credit group & type FE | No | Yes | No | Yes |

*Notes:* *** $p<0.001$, ** $p<0.01$, * $p<0.05$. Source: Federal Reserve Bank of New York's Consumer Credit Panel/Equifax data (CCP) with author's calculations.

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# Robustness: Lagged Limit Left

| | *Independent variable:* Lagged share limit remaining | | | |
|---|---|---|---|---|
| | OLS | OLS | IV | IV |
| | (1) | (2) | (3) | (4) |
| Term Length Above 60 | −0.406*** | −0.529*** | −0.266*** | −0.445*** |
| | (0.0312) | (0.0292) | (0.0500) | (0.0324) |
| Observations | 307,909 | 299,864 | 298,311 | 276,480 |
| Term mean | 62.49 | 62.50 | 62.50 | 62.30 |
| Indep. var. sd. | 0.389 | 0.311 | 0.310 | 0.397 |
| F-stat (above 60) | – | – | 346.0 | 269.7 |
| Credit group & type FE | No | Yes | No | Yes |

*Notes:* *** $p<0.001$, ** $p<0.01$, * $p<0.05$. Source: Federal Reserve Bank of New York's Consumer Credit Panel/Equifax data (CCP) with author's calculations.

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# Households *less* liquidity constrained over time