Berger, Milbradt, Tourre and Vavra (2023): Refinancing Frictions, Mortgage Pricing and Redistribution

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Motivation: How to Design the Mortgage System?

- Housing: long-duration asset - how to finance it?

- 30yr US fixed-rate mortgage (FRM) not obvious!
  - Financial stability risks
  - Lock-in

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- 30yr US fixed-rate mortgage (FRM) not obvious!
  - Financial stability risks
  - Lock-in
  - Monetary policy pass-through
  - **Refinancing inequality**

- 30yr fixed rate, with prepayment option:
  - Households have to exercise attention and action to obtain lower rates
  - Households who are more attentive (and have larger stakes) pay lower rates

This Paper

- Obvious solution: why not have **automatically-refinancing mortgages**? ("auto-RMs")

- **Idea:** But more frequent prepayment reduces MBS investor cashflows $\rightarrow$ eqm rates need to rise to compensate, with redistributional consequences
  - Solve for eqm prices w/ heterogenously attentive HHs & competitive MBS investors
  - Evaluate separating, pooling, auto-RM equilibrium
  - More broadly, develop method to compute eqm pricing with state-dependent selection

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- **Main findings:**
  - Fast borrowers pay 148bp more in separating compared to pooling equilibrium
  - Auto-RM counterfactual: raises mortgage rates by 89bp → may affect credit access
  - Other applications: differential attention e.g. with non-bank lenders, eqm. effect on rates

Discussion Points

Important methodological + conceptual contribution

Outline:

1. Intuition + key assumptions

2. Notion of equilibrium

3. Interpretation and measurement of χ

4. Framing

5. Other eqm effects on mortgage rates

Recasting Intuition: Equilibrium Pricing in a (State-Dependent) Selection Market

- HHs are heterogeneous in unobservable, but cashflow-relevant characteristic χ

- Cashflows generated from HHs are risky and depend on χ and state variable x

- Firms (investors) charge prices P such that they break even
  - In a separating equilibrium where firms can price on χ, $P(\bar{\chi}) \geq P(\underline{\chi})$ where $\bar{\chi} \geq \underline{\chi}$
  - In a pooling equilibrium, $P(\bar{\chi}) \geq P^* \left(E\left[g(\chi \mid x) \right] \right) \geq P(\underline{\chi})$
  - In eqm where everyone has $\bar{\chi}$, $P^{**} \left(E\left[g'(\bar{\chi} \mid x) \right] \right)$?

Recasting Intuition: Equilibrium Pricing in a (State-Dependent) Selection Market

- Mortgage borrowers are heterogeneous in unobservable attention χ

- MBS cashflows are risky and depend on χ and interest rate level x

- MBS investors charge prices P such that they break even
  - In a separating equilibrium where firms can price on χ, $P(\bar{\chi}) \geq P(\underline{\chi})$ where $\bar{\chi} \geq \underline{\chi}$
  - In a pooling equilibrium, $P(\bar{\chi}) \geq P^* \left(E\left[g(\chi \mid x)\right] \right) \geq P(\underline{\chi})$
  - In auto-RM eqm, everyone has $\bar{\chi}$. $P^{**} \left(E\left[g'(\bar{\chi} \mid x)\right] \right)$?

- Challenge: equilibrium MBS price P^*, P^{**} in pooling, auto-RM eqm?

Optimal Household Refinancing & MBS Cash Flows: Intuition

(1) Optimal Household Refinancing

(2) MBS Cash Flows: "pass-through securities"

Optimal Household Refinancing & MBS Cash Flows: Intuition

(1) Optimal Household Refinancing

- Fixed-rate mortgage: if interest rates decrease, should consider to refinance

- Should refinance if "refinancing benefit $\geq$ refinancing cost", i.e.

$$\underbrace{[\text{PV of payments}(c) - \text{PV of payments}(m_t)}_{f(\text{rate gap } \theta, \text{loan balance } M)} + \underbrace{\Delta\text{refi option value}}_{\sigma} > \kappa$$

- Agarwal-Driscoll-Laibson ("ADL", 2013): closed-form solution for optimal rate gap θ^*
  - Under some assumptions: random walk, risk-neutral HHs, specific repayment path etc.

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(2) MBS Cash Flows: "pass-through securities"

– Discounted coupon payments (net of fees) + discounted principal

$$\mathbb{E}_x \left[\int_0^\tau e^{-\int_0^t r(x_s)ds}(c-f)dt + e^{-\int_0^\tau r(x_s)ds} \right]$$

$\rightarrow$ Discounted cashflows depend on x and prepayment time $\tau \rightarrow$ attention rate χ

Optimal Household Refinancing with Inattention

- Optimal refinancing rate gap with inattention:

$$\hat{\theta} = \sqrt{\frac{2}{\eta_0}\left(1 + \frac{\epsilon_\chi}{\eta_0}\right)(\rho + \nu)\psi + \left(\frac{\epsilon_\chi}{\eta_0^2}\right)^2} - \frac{\epsilon_\chi}{\eta_0^2}$$

where

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- Compare to ADL formula (BMTV notation):

$$\theta^{*ADL} = \frac{1}{\eta_0}\left[1 + \eta_0\kappa/M(\rho+\nu) + W\left(-\exp\left(-1 - \eta_0\kappa/M(\rho+\nu)\right)\right)\right]$$

  - where $\kappa = \psi M + \kappa^{fix}$
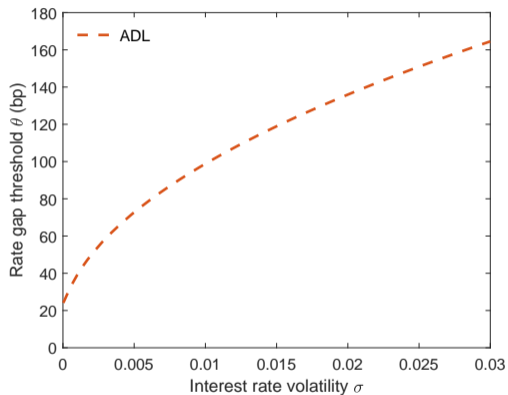
$\rightarrow$ Include household attention, but also abstract from fixed cost / role of loan size M

Optimal Refinancing Threshold: ADL

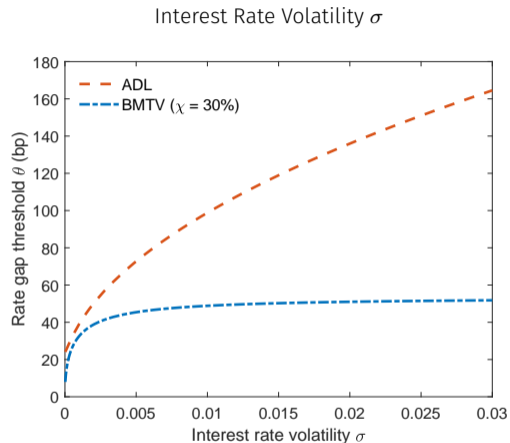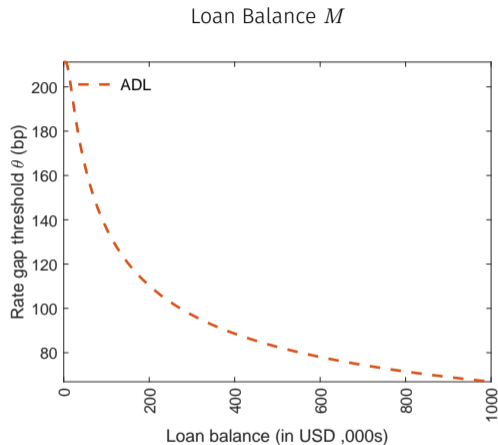Loan Balance M — Interest Rate Volatility σ
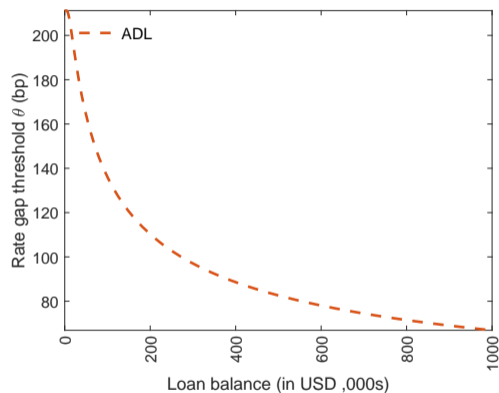
ADL: $\kappa = 0.01 \cdot M + 1000$, $\sigma = 0.0109$, $M = 250{,}000$

$\rightarrow$ Loan size M, interest rate volatility matters ...

Optimal Refinancing Threshold: ADL vs. BMTV

Loan Balance M Interest Rate Volatility σ

ADL: $\kappa = 0.01 \cdot M + 1000$, $\sigma = 0.0109$, $M = 250{,}000$

$\rightarrow$ ... but less so in modified formula (with fully scaling cost / inattention)

What Do We Make of (Modified) ADL Formula?

- Goal: intuition for inattention

- If we were to use the formula for eqm characterization, would add more on intuition and comparative statics (w.r.t. σ, how to interpret level of χ ...)

- But: if not used further, less emphasis / focus on assumptions for eqm characterization?

- Aside: maybe useful for empirical applications (back out implied χ distribution based on realized rate gap at refi?); similar to ADL applications, typically empirical

- This is because ....

Key Assumption Going Forward: No Upfront-Cost of Refinancing

- ... Do we use this formula for optimal mortgage refinancing with inattention for eqm characterization?
  - No, because eqm mortgage rate may not follow random walk

- To characterize unique MPE: assume no upfront cost of refinancing ($\psi = 0$)
  - ⇒ Refi if: rate gap is positive + you're attentive

$$\theta(x) = 0, \text{ optimal refinancing choice is } a^*(x, c) = \mathbb{I}_{\{c \geq m(x)\}}$$

- Paper is very careful to show that fixed costs should not materially affect eqm pricing

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- Thoughts:
  - Fixed cost (even hassle cost) + loan size matter for refinancing behavior empirically
  - I don't think this is an impediment for the paper - focus on eqm characterization
  - Maybe helpful to think about: HHs in a way both "excessively" refinancing *and* inattentive, ignoring loan size distribution - do we get upper bound / lower bound results? Direction of any potential bias?

Mortgage Market Equilibrium with Heterogeneous Households

- Distribution of χ: infinite-dimensional state space

- Idea: approximate cross-sectional distribution over households' coupons and attention rates (heterogeneous-agent macro literature, e.g. Krusell & Smith 1998)

- Gives state-dependent origination distribution of types:

$$g(\chi \mid x) = \frac{h(\chi)\left(\nu + \chi \int_{c \geq m(x)} f_\infty(c \mid x, \chi)dc\right)}{\int_\chi h(\chi)\left(\nu + \chi \int_{c \geq m(x)} f_\infty(c \mid x, \chi)dc\right)d\chi}.$$

- Can solve for unique pooling MPE with $E^{G_t}[P(S_t, m(S_t); \chi)] := 1 + \pi$ under some assumptions:
  - A1: No upfront closing costs.
  - A2: Investor bounded rationality: value mortgages based on average distribution of attention (cross-sectional origination distribution that is either (i) a constant $G(\chi)$ or (ii) a state-dependent function $G(\chi \mid x)$).
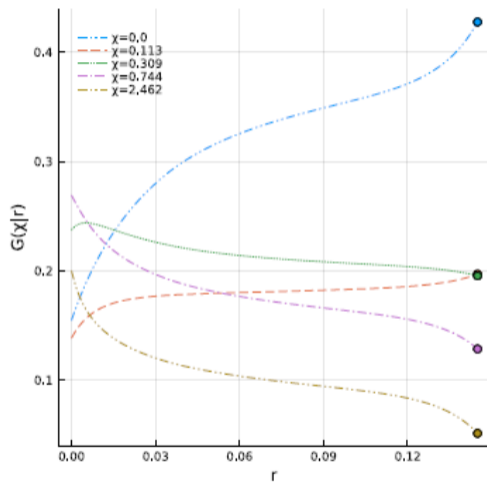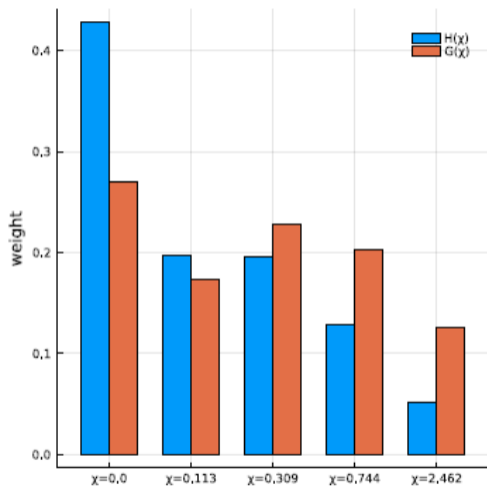
Counterfactuals

1. Auto-RM, i.e., "a mortgage whose coupon rate automatically resets to the prevailing market rate if that rate is below the mortgage coupon"
   - Now: refi if gap positive (regardless of attentive)
   - Auto-RM ergodic avg mortgage rate difference 89bp higher than pooling eqm
   - Rise in rate pushes some households above DTI limit (may affect extensive margin of credit access)
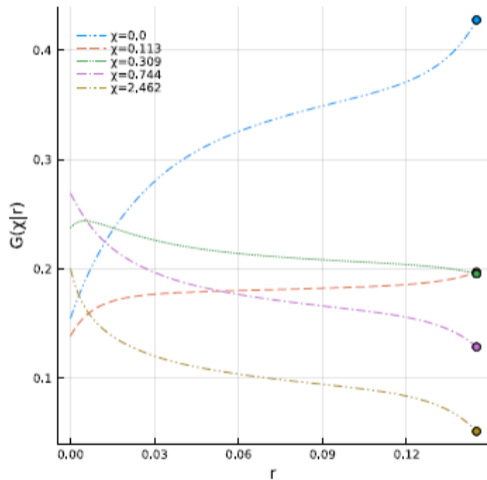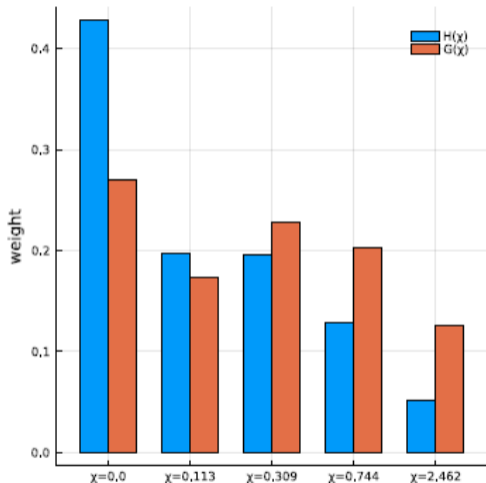
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2. Rise of non-bank lending
   - Non-bank borrowers appear more attentive: higher refi propensity for given rate gap
   - An average increase in χ by 12% raises ergodic avg mortgage rate up by 35bp

3. Other applications:
   - State-dependent selection in labor markets (job switching, χ e.g. productivity, may vary with state of business cycle x)

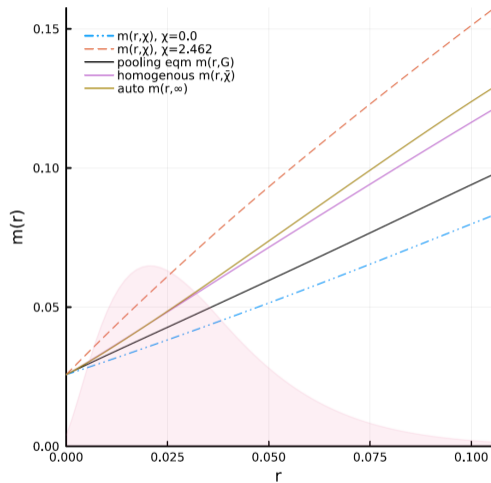# Attention Distribution (Population vs Origination vs State-Dependent)

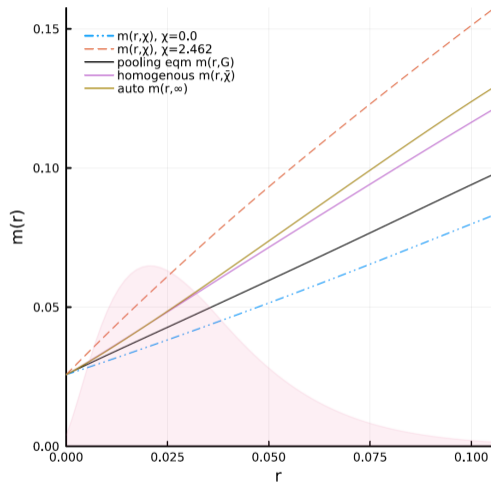# Attention Distribution (Population vs Origination vs State-Dependent)

$\rightarrow$ State-dependent selection problem for MBS pricing

Counterfactual Mortgage Rates (Separating / Pooling / Auto-RM Eqm)

Counterfactual Mortgage Rates (Separating / Pooling / Auto-RM Eqm)

→ Eqm pricing effects can be quite large (that's why we need a model)

Comment 1: Notion of Equilibrium and Emphasis

- This paper: perspective of MBS investor: faced with this state-dependent attention distribution, how to set prices

- Eqm: "quantity supplied = quantity demanded at eqm price"

- Not much households can do: refi if attentive and rate gap positive ($c \geq m(x)$)
  - Attentiveness is exogenously given, no role for refi cost
  - No adjustment in loan demand, i.e. loan demand elasticity wrt mortgage rate is 0

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- Other papers:
  - Also on dynamic selection, e.g. Nelson (2022): unravelling of market segments when χ changes (previously observed portion of χ becomes unobservable), extensive margin
  - Redistribution in the mortgage market and refinancing: Fisher et al 2022, Zhang 2022

$\rightarrow$ Why is the perspective of this paper instructive? e.g. eqm price effects from intro of auto-RMs potentially large

Comment 2: Interpretation and Measurement of χ

- Total prepayment intensity: $\chi_i^{total}(gap) = \chi^{base} + \chi_i \mathbb{I}_{gap > \theta}$

- Clustering algorithm with $N = 5$ to calibrate model

- But when mapping to data, χ does some heavy lifting: picks up home equity constraints, credit events?, variation in loan size / refi incentive, fixed cost, actual inattention ...

- May matter for some counterfactual scenarios as it affects stability of χ in the data and ability to extrapolate
  - Any event where distribution of χ at origination shifted exogenously? (Covid? But may be difficult to interpret, see below)
  - Or exploit exogenous variation in gap? (e.g. Fonseca & Liu, 2023)

Comment 3: Framing of the Paper

Key finding: eqm mortgage rate with auto-RM mortgages vs. separating vs. pooling eqm.

What's the consistent thread running through the paper?

- (A) Methods paper with applications

- (B) Quantify redistributional effects of refinancing frictions

- (C) State-dependent selection market
  - In the mortgage market, state-dependent selection matters for eqm pricing.
  - Many interesting counterfactuals, in particular auto-RMs, require a solution for eqm price.
  - Develop methodology to do so, and study counterfactuals and redistributive effects under differential counterfactual selection patterns (e.g. auto-RM where χ shift most extreme, less extreme: increase in attention with non-bank lenders).

Comment 4: Other Eqm Effects on Mortgage Rates?

- Auto-RM raises eqm mortgage rate substantially

- Any other (eqm) forces that could push in the other direction?
  - MBS prepayment risk premium? (Boyarchenko et al 2019)
  - Any way it could raise competition? Role of capacity constraints, other supply-side frictions which dominated pricing effects during Covid (Fuster–Vickery, Fuster et al 2023) (even though plausibly shock to χ)

Other Comments

- Somewhere a homotheticity assumption built in that things scale with loan size (in reality, some relationships may be highly nonlinear) - may be helpful to explain

- Can there be other forms of unraveling? If distribution known to HHs as well, could there be incentives to delay refinancing to be "pooled in a different x cohort" and obtain a lower eqm price?

- Cross-validating eqm mortgage rates - not too difficult to match time series of mortgage rates (10yr treasury + 170bp) - any event where distribution of χ at origination shifted? (Covid? But may be confounded by supply frictions..)

Conclusion

- A really exciting and educational paper!
  - Methodological and conceptual contribution: how to describe eqm pricing in mortgage market given state-dependent selection
  - Quantify redistributive effects of auto-RMs, substantially higher eqm mortgage rates
  - Potentially useful for other eqm mortgage pricing questions (rate rises?)

- Focus the draft, explain eqm, bound the magnitude of alternative effects

- Look forward to future iterations and alternative applications.