Asymmetric Information and the Supply Chain of Mortgages: The Case of Ginnie Mae Loans

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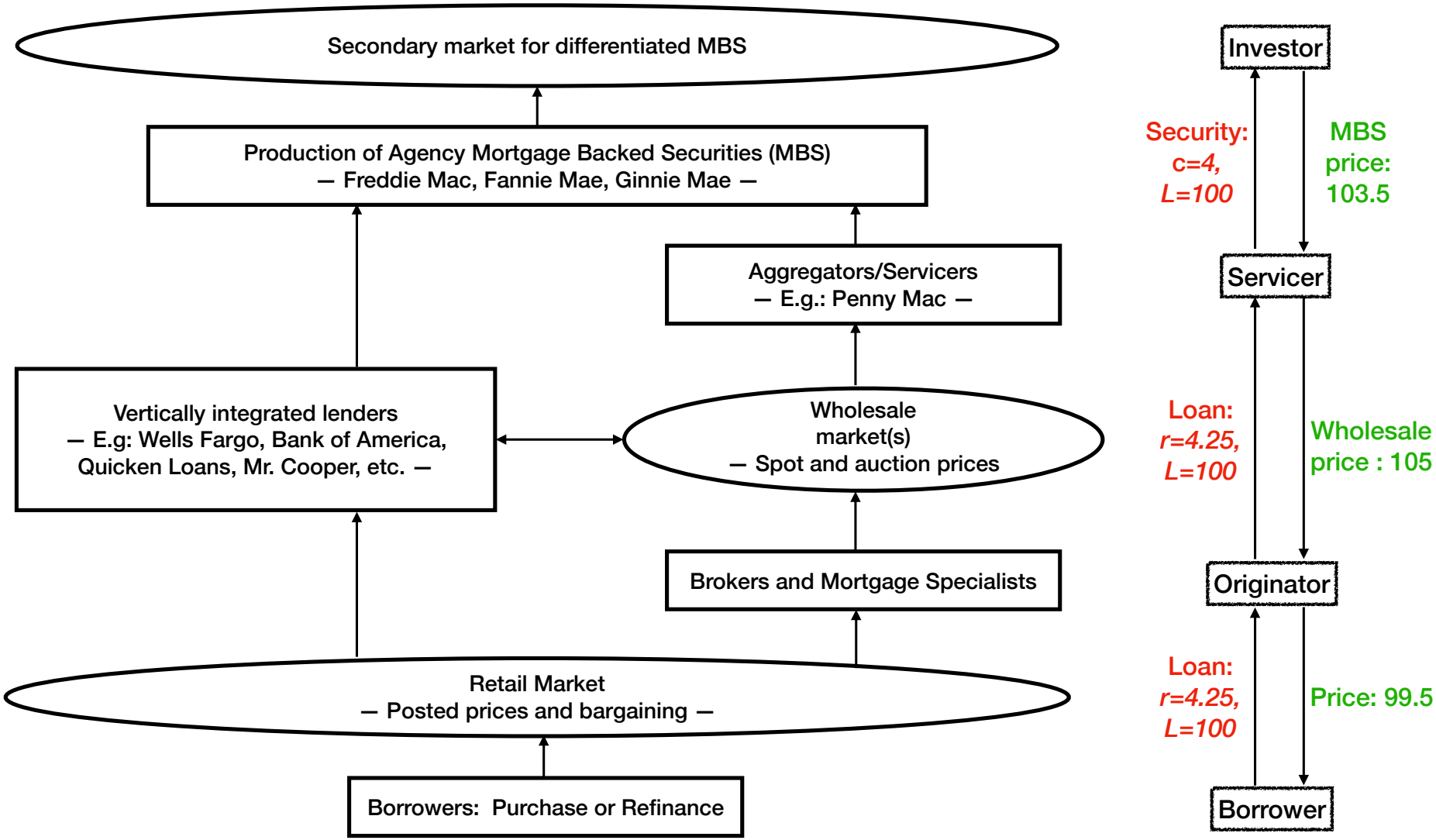
Originate-to-Distribution (OTD) Supply Chain of Mortgages



Loan Values to Servicers

- Sellers in MBS market sell loans, but typically retain servicing rights
  - Collect monthly interest payment from borrower at note rate r
  - Pays the agency for insuring loan against default at rate g
  - Pays the MBS coupon c to investors
  - Keeps the difference: $r - g - c$ (measured in p.p.)

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- **Key decisions by banks:**
  - Security customization: (i) coupon, (ii) custom/multi-issuer pool
  - Acquisition price/bid: (i) wholesale price, (ii) upfront fee

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- Why?
  - Private signals about *pre-payment risk* leads to a *Winner's Curse* in the wholesale market, and *Lemon's problem* in the MBS market
    - ★ Asymmetric information: Lower loan acquisition **and** MBS prices
    - ★ Borrowing costs are inversely proportional to loan value
  - IO/Bank competition literature:
    - ★ Banks have common beliefs about loan duration
    - ★ Price dispersion is due to idiosyncratic origination/servicing costs

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Case study: Wholesale/secondary markets for Ginnie Mae mortgages

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1. Adverse selection in the MBS market:
   - Variation: Limited ability to customize securities
   - Chiappori and Salanié's correlation test:
     - ★ Do sellers place higher duration loans in low coupon (high service-income) securities?
     - ★ Do they sell higher-duration loans in a custom pool security?
   - Moral Hazard vs Adverse-selection

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2. Common-value test:
   - Auctions for loans *without* a coupon-choice option
   - Correlation between (residual) bids and loan duration (as in Hendricks, Pinkse and Porter)
   - Are lenders asymmetrically informed?

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   - Are lenders asymmetrically informed?
3. Security customization and the Winner's Curse
   - What is the effect of the coupon-choice on bids and markups?

Summary of Findings

- Main results:
  1. Auctions price pre-payment risk more efficiently than posted-prices
  2. Wholesale auctions have a significant common value component, and lenders are not equally informed: Winner's Curse
  3. Asymmetric information leads to adverse selection in the MBS market.
  4. Ability to customize securities increases market power

Summary of Findings

- Main results:
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- Implications:
  1. Auctions improve information available to upstream lenders, and can lower securitization cost
  2. Market unraveling?
     - ★ Ability to customize MBS lower the value of "multi-issuer" pools
     - ★ Wholesale market design determines the size of the wholesale market

  $\Rightarrow$ Information frictions *upstream* affect competition *downstream*

Related Literature

- Bank competition in the lending markets:
  - *Price dispersion:* Search frictions, differentiation, and cost differences
  - *References:* Allen et al (2015,2019), Crawford et al. (2018), Clark et al (2019), **Buchak et al. (2019, forthcoming)**, Grigsby et al. (2020), Robles-Garcia (2022)

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- The cost of financial intermediation:
  - *Originate-to-Distribute and Fintechs:* Stanton et al. (2014), Fuster et al. (2019, 2022)
  - *Asymmetric information in MBS markets:* Bernardo and Cornell (1997), **DeMarzo (2005)**, Downing et al (2008), Agarwal et al (2012)

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  - *Asymmetric information in MBS markets:* Bernardo and Cornell (1997), **DeMarzo (2005)**, Downing et al (2008), Agarwal et al (2012)
- Asymmetric information in other markets:
  - *Adverse-selection:* Chiappori and Salanié (2000), Cohen and Einav (2007), Adams, Einav and Levin (2012), Illanes and Padi (2021)
  - *Common-value:* **Hendricks et al. (2003)**, Bhattacharya et al. (2022)

Outline

Secondary (MBS) market

- To-Be-Announced (TBA) forward market: Multi-issuers
  - Bank agrees to delivery a pool of agency-insured loans to a buyer at a specified price, par value, coupon, maturity, and delivery date.
  - Identity of loans unknown to buyer at trade date.
- Custom pool market: Single-issuer.
  - Identities of the loans are known to buyer at the trade date.
  - Roughly 25% in our sample (up from less than 10% in 2010)
- Customization decisions:
  - *Coupon:* Service income $(r - c)$
  - *Pool:* Custom or Multi-issuer

Wholesale Market

- Two market segments:
  - *Posted prices:* Wholesale rate-sheets or *Lock* prices
    - ★ Lock price = Base $(r, \text{lock period})$ + Loan-level adjustments (LLPA)
    - ★ Base prices are updated daily
    - ★ LLPA are based on *coarse* information
  - *Online auctions:* Flexible real-time pricing
    - ★ Information: Originator, Note-rate, Zip-code, Agency, Income, DTI, Size, FICO, Purchase/Refi

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- Optimal Blue (OB) loan exchange platform:
  - Active in both segments: $\approx 35\%$ market-share (prior to 2021)
  - 75% of loan exchanges done via auctions

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  - 75% of loan exchanges done via auctions
- Auction design (since 2018):
  - Loan-level first-price sealed bid auction ($\approx$ 1-2 hrs)
  - Sellers invite buyers form their network (fixed)
  - Buyer-specific reserve price: Bid = max$\{$Bulk, Lock$\}$

Data Sources

- eMBS: provides detailed information on all agency MBSs and their component loans from January 2013 to present.
  - Observe monthly payment history until loan is prepaid.
  - Identity of seller
- Optimal Blue: auction data from Jan 2018 to present.
- HMDA: provides detailed information on all loans originated between 2013 to present, including identity of originator.
  - HDMA-eMBS: track loans from origination to securitization (retail vs non-retail) for HMDA sample period
  - HDMA-OB-eMBS: track loans from origination to auction to securitization for OB sample period
  - Match rates: OB - eMBS is 86%, HMDA-OB is 82%.
- Bloomberg for MBS prices (TBA)

Sample

- **Sample:** 30-year fixed rate mortgages insured by Ginnie Mae, and benefit from Federal housing subsidies (FHA+VA)
- Why Ginnie?
  - riskier loans: $LTV > 0.8$
  - limited security customization
  - guarantee fee is fixed at 6 basis points for all lenders.
- Ginnie Mae share $\approx 25\%$ of loan origination
- Loan performance:
  - $1(T_i > 12)$: 12-month survival
  - Combine pre-payment and default risk
  - Why? Default risk is insured by Agency

Summary statistics

Source: eMBS + OB

	Full sample		Matched sample	
	mean	sd	mean	sd
Note rate	4.2	.56	4.4	.61
Loan (x100K)	2.2	1.1	2.3	1
LTV	95	8.4	96	7
Credit Score	688	54	687	52
DTI	41	9.6	43	10
1(DTI $>$ 40)	.58	.49	.63	.48
1(VA)	.34	.47	.29	.45
1(New purchase)	.76	.43	.83	.37
1(Retail)	.39	.49	.0023	.048
1(Correspondent)	.49	.5	.97	.16
Loan survival: 12 months	89	31	82	38
Loan survival: 36 months	57	50	30	46
Observations	751,794		59,821	
Period	2013-2019		2018-2019	

Auction Summary Statistics

Source: OB 2018-2019

	mean	sd	p10	p50	p90
Client network size	18	4.7	12	17	26
Fraction network invited	.71	.17	.48	.74	.93
TBA Price ($)	103	1	102	103	104
Bid ($)	104	1.3	103	104	106
Winning bid ($)	105	1.3	104	105	107
Bulk - TBA ($)	1.6	.85	.65	1.6	2.5
Lock price - TBA ($)	1.1	.94	-.055	1.3	2.1
Fraction bulk bids	.7	.2	.45	.75	.92
1(Bulk winning bid)	.9	.3	0	1	1
Winning margin: 1st - 2nd bid ($)	.21	.23	.021	.14	.5
Gain: Winning bid - Highest lock ($)	.73	.84	0	.45	1.8
Observations	670,562				
Auctions	61,583				

Pricing of Short-term Prepayment Risk

$\Pr(Survival|Z_i) = \Phi(Z_i\beta + \text{Auction month} + \text{County})$

$\text{Net bid}_i = \lambda \Pr(Survival|Z_i) + \text{Date} \times \text{Rate} + \epsilon_i$

VARIABLES	(1) Bulk bid	(2) Lock bid	(3) Winning bid
Predicted survival prob. (/SD)	0.16*	0.061*	0.26*
	(0.0014)	(0.0023)	(0.0030)
Observations	480,419	187,006	59,821
R-squared	0.207	0.269	0.412
Across auction dispersion (std-dev)	0.58	0.58	0.58
Survival prob. std-dev	0.15	0.15	0.15

Takeaway

- *Bulk bids price pre-payment risk more accurately than lock*
- *Cost of 12-month survival risk:* 15% *increase in survival probability* = \$0.26 *(45% of across auctions bid dispersion).*

Hedonic bid regression

Bid Dispersion

	(1)	(2)	(3)	(4)
Baseline	✓	✓	✓	✓
Buyer FE		✓	✓	✓
Buyer-specific slopes			✓	✓
Buyer-seller FE				✓
R-squared	0.27	0.42	0.57	0.61
Standard-deviation residual	0.71	0.64	0.54	0.52

- Baseline: Loan size, FICO, DTI, Income, Purchase, FHA, Fixed-effects (Sellers, date x rate, county)
- Bidder asymmetries:
  - 30-point increase from bidder-specific intercepts and slopes
  - 4-point increase from seller-specific relationships

Within vs across bid dispersion

Model: Ex-post Loan Valuation

- *Realized cash flows* for \$100 loan i:

$$R_i(c) = P_i(c) + \underbrace{\sum_{\tau=1}^{T} \delta^{\tau} L_{\tau,i}}_{\text{service multiple } (M_i)} \times \underbrace{\frac{r_i - g - c}{1200}}_{\text{service income}} - \text{Fixed cost}$$

  - $P_i(c)$ is the MBS security price
  - $L_{\tau,i}$ is unpaid balance at end of month τ.
  - T is the (random) duration of the loan.

- Security price:
  - TBA price depends (increasing) on c, but not on (z, r).
  - Custom pool price depends on c AND (z, r) of every loan in the pool.

Information Structure

- **Two models of values:**
  - PV model:
    - ★ Additive, idiosyncratic value shock S_{ij}
    - ★ Common beliefs about duration $M_i|Z_i$
    - ★ *Implication:* Dispersion in bids reflects dispersion in cost
  - CV model:
    - ★ Bidders receive private signals S_{ij} about $M_i|Z_i \Rightarrow$ heterogenous beliefs
    - ★ *Implication:* Dispersion in bids reflects dispersion in expectations

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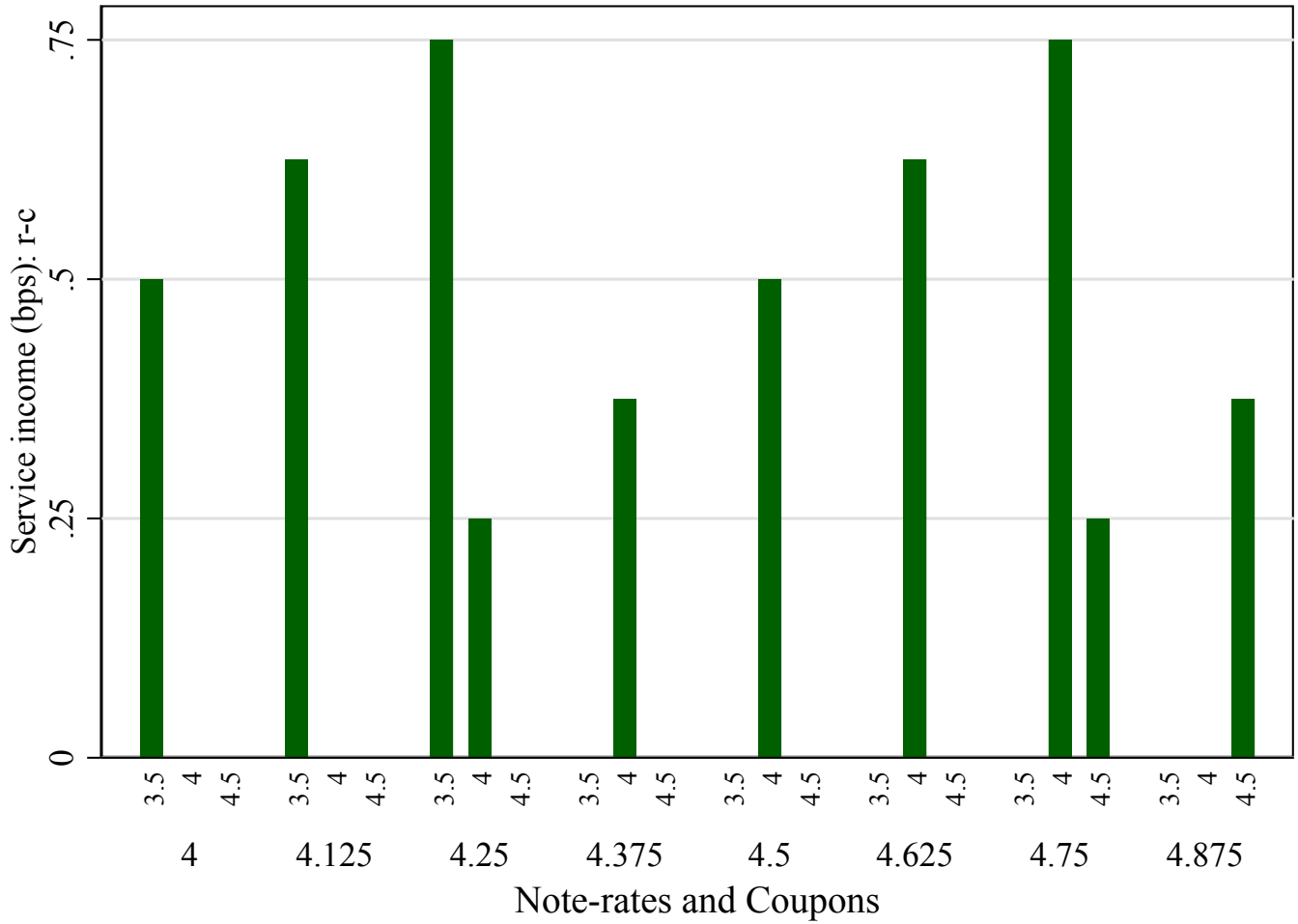
- **Timing:**
  1. Private signals: S_{ij}
  2. Bid preparation: B_{ij}
  3. Securitization: (i) coupon choice, (ii) custom/multi pool

Securitization: Coupon choice

- **Regulation:** $(r - c) \in [0.25, 0.75]$
  - r is quoted in 0.125 increments, and c is quoted in 0.5 increments
  - Coupon choice when r ends in 0.25/0.75: $c_H > c_L$



Securitization: Coupon choice

- **Key:** TBA price reflects the risk composition of the (giant) pool
- **Tradeoff:** Markup vs Upfront TBA price

$$\max_{c \in \{c_L, c_H\}} \frac{(r - c - g)}{1200} \bar{M}_i + P_c^{tba} - F_i$$

$$\Rightarrow c_i = c_H \text{ if } \bar{M}_i \leq \frac{P_H^{tba} - P_L^{tba}}{(c_H - c_L)/1200}$$

- **Testable implication:** Loans placed in High-coupon securities (*low service income*) are more likely to be pre-paid early
  - Adverse-selection: (i) observed locan characteristics (Z_i), and (ii) private information (S_i)

Securitization: Custom vs Multi-issuer Pool

- **Security price:** Custom vs Multi

$$P_c^{custom} = c \times E[M_i | \text{Bank } j\text{'s custom pool}]$$

$$P_c^{tba} = c \times E[M_i | \text{Multi-issuer pool}]$$

- **Cutoff-strategy:**
  - Rank loans in portfolio for coupon c:

$$\bar{M}_1 > \bar{M}_2 > \cdots > \bar{M}_n$$

  - Loans with $\bar{M}_i > m_c^*$ are placed in custom-pool
  - Tradeoff: (i) security price, and (ii) securitization cost/diversification

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Auction: Winner's Curse

- Willingess-to-pay:

$$\text{CV: } v_{ij} = \max_{c,s} \quad (r - c - g) \times \bar{M}(Z_i, \mathbf{S_{ij}}) + P_c^s - F_i^s$$

$$\text{PV: } v_{ij} = \max_{c,s} \quad (r - c - g) \times \bar{M}(Z_i) + P_c^s - F_i^s - \mathbf{S_{ij}}$$

  where F_i^s is the common-component of cost.
- Predictions:
  - **PV:** Banks choose the same coupon/security $\Rightarrow$ Differences in $\bar{M}$ are competed away
  - **CV:** Rival signals are informative about v_{ij} $\Rightarrow$ Winner's Curse

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- **Testable implications of common-value:**
  - *Monotonicity:* Higher value loans are less likely to be pre-paid early
  - *Winner's curse:* Max rival bids is positively correlated with duration
  - *Dispersion:* Within auctions, bids are less dispersed for loans without coupon choice

Empirical Tests

- Survival regressions:

$$
\begin{aligned}
Y_i &= \lambda \text{Security choice}_{ij} + \text{Fixed-effects} + Z_i\beta + \epsilon_i \\
Y_i &= \lambda_{\text{own}} \text{Bid}_{ij} + \lambda_{\text{rival}} \text{Rival Bid}_{ij} + \text{Fixed-effects} + Z_i\beta + \epsilon_i
\end{aligned}
$$

  where $Y_i = 100 \times 1(T_i > 12)$, and Fixed-effects include $r \times t$.

  Control variables

- Adverse-selection tests (Chiappori and Salanié): $\lambda < 0$
  - Coupon choice: $\lambda_{\text{high}} < 0$
  - Security choice: $\lambda_{\text{multi}} < 0$
- Common-value tests (Hendricks, Pinkse and Porter):
  - Proxy for private signal $\Rightarrow$ Bid residual (w/ bank-specific slopes)
  - PV: $\lambda_{\text{own}} = \lambda_{\text{rival}} = 0$
  - CV: $\lambda_{\text{own}} > 0$ (monotonicity) and $\lambda_{\text{rival}} > 0$ (Winner's Curse)

Results: Adverse-selection (1)

VARIABLES	(1)	(2)	(3)	(4) Retail	(5) Wholesale
Panel A: Coupon choice					
1(High coupon)	-3.96	-2.63	-1.61	-0.93	-0.90
	(0.35)	(0.33)	(0.26)	(0.31)	(0.28)
Obs.	2,627,016	2,627,016	2,619,080	1,067,970	1,481,475
Loan charact.	no	yes	yes	yes	yes
Fixed effects	$r \times t$	$r \times t$	$r \times t \times f$	$r \times t \times f$	$r \times t \times f$
Mean dep. var.	89.2	89.2	89.2	89.1	89.6
% Multi-issuer pool	0.83	0.83	0.83	0.86	0.78
% High Coupon	0.87	0.87	0.87	0.87	0.87

Takeaway

- *Holding fixed r, loans placed in high-coupon (low service income) are $\approx$ 4% more likely to get pre-paid within 12 mo.*
- *Pricing of MBS: 65% of adverse-selection is due to observables*
- **Firm asymmetries:** *Banks who never use low-coupon (i.e. high liquidity needs) supply less performing loans*

Results: Adverse-selection (2)

VARIABLES	(1)	(2)	(3)	(4) Retail	(5) Wholesale
Panel B: Pool type					
1(Multi-issuer pool)	-10.0	-4.27	-2.87	-3.07	-2.62
	(0.29)	(0.22)	(0.22)	(0.23)	(0.22)
Obs.	8,469,486	8,469,486	8,438,337	3,348,467	3,959,362
Loan charact.	no	yes	yes	yes	yes
Fixed effects	$r \times t$	$r \times t$	$r \times t \times f$	$r \times t \times f$	$r \times t \times f$
Mean dep. var.	89.2	89.2	89.2	89.1	89.6
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% High Coupon	0.87	0.87	0.87	0.87	0.87

Takeaway

- **Adverse-selection:** *Loans placed in multi-issuer pools are adverse-selected*
- **Firm asymmetries:** *Banks who never use multi-issuer pools (i.e. small lenders) supply less performing loans*

Adverse selection vs Moral hazard

Moral Hazard or Adverse Selection?

- Do lenders encourage borrowers to refinance their loans early so they can earn higher service income on new loan?
- Test using sample of loans **not** eligible for a coupon choice - i.e., note rates that end in 0.375, 0.5, and 0.625.
- Regression:

$$\begin{aligned} Y_i &= \lambda_1 1\{r_i - c_i = 0.5\} + \lambda_2 1\{r_i - c_i = 0.625\} \\ &\quad + g(r_i) + Z_i\beta + \text{Fixed Effects} + u_i \end{aligned}$$

  - Loans with higher rates get pre-paid early: $g'(r) < 0$
  - Loans with higher spread $r - c$ likely to be pre-paid if hypothesis is true $\Rightarrow \lambda_2 > \lambda_1 > 0$.

Results: Moral Hazard

VARIABLES	(1)	(2)	(3)	(4) Retail	(5) Wholesale
Panel C: Service income					
$r - c = 500$ bbs	0.40	0.046	-0.39	-0.31	-0.45
	(0.15)	(0.15)	(0.11)	(0.12)	(0.13)
$r - c = 625$ bbs	1.05	0.60	-0.065	-0.11	-0.046
	(0.16)	(0.16)	(0.11)	(0.13)	(0.13)
Observations	4,385,138	4,385,138	4,384,537	1,819,522	1,970,036
Loan characteristics	rate+loan	all	all	all	all
Fixed effects	t	t	$t \times f$	$t \times f$	$t \times f$
Mean dep. var.	89.2	89.2	89.2	89.1	89.6

Takeaway

- *Reject Moral Hazard hypothesis:*
  - *More profitable loans are slightly more likely to survive*
  - *Difference is fully explained by observed differences cross loans/banks*

Results: Common-Value

Regression: $1(T_i > 12) = \lambda[\text{Bid variables}] + Z_i\beta + \text{Date} \times \text{Rate} + \text{County} + \text{Seller} + \epsilon_{ij}$

VARIABLES	(1) Bids	(2) Bids	(3) Residual	(4) Residual	(5) Winning bid	(6) Winning bid
Net bid	0.35*	0.13*			3.13*	3.07*
	(0.056)	(0.045)			(0.34)	(0.34)
Max rival bid		2.62*				
		(0.26)				
Bid residual			0.59*	0.36*		
			(0.078)	(0.067)		
Max rival residual				0.85*		
				(0.15)		
% bulk bids						3.42*
						(1.07)
Observations	666,099	666,099	437,402	381,010	59,353	59,353

Takeaway

- **Winner's curse:** *Max. rival bids/winning bids are more informative*
  - *\$0.75 ↑ in win. bid → 3.13% ↓ in pre-payment ($\approx$ 10%)*
- **Comparison:** *Refi. loans are 3.88% less likely to survive*

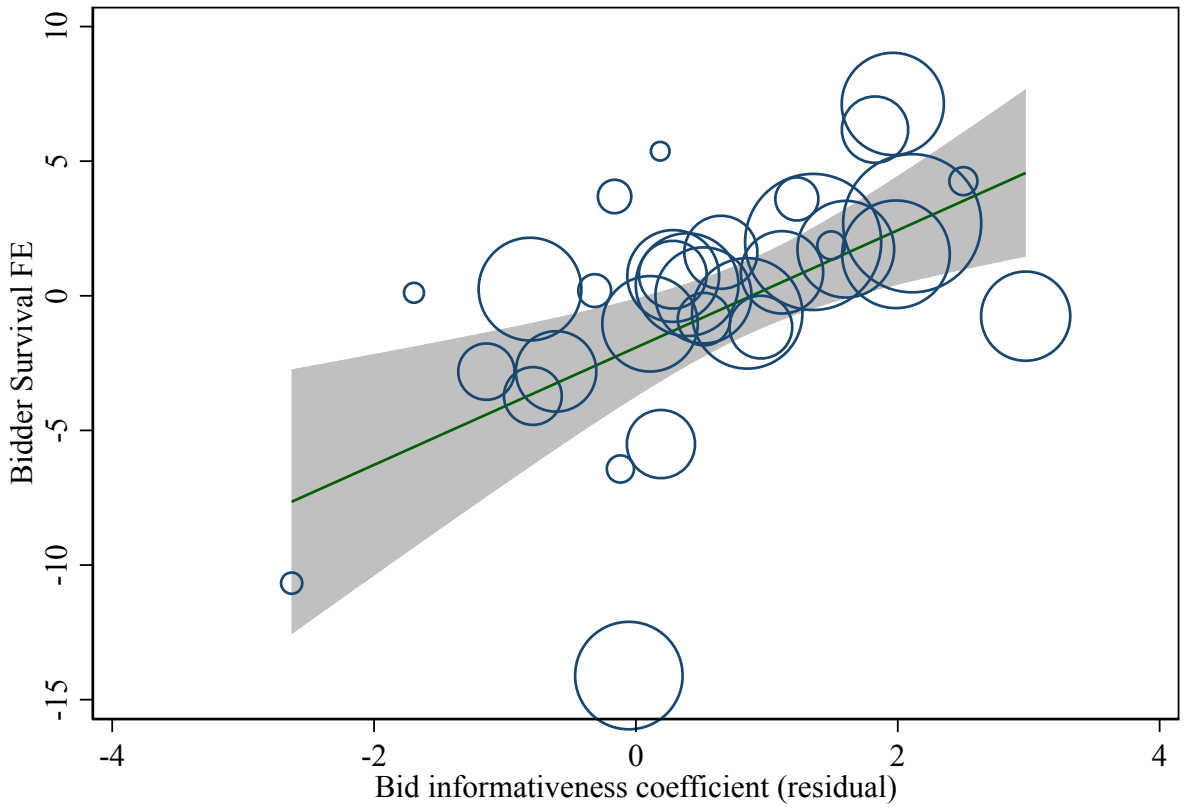
Asymmetries in Signals

- **Bid informativeness:** Same regression as before with bidder-level slopes

$$1(T_i > T) = \lambda_j \text{Bid residual}_{ij} + Z_i\beta + \text{Fixed effects} + \epsilon$$

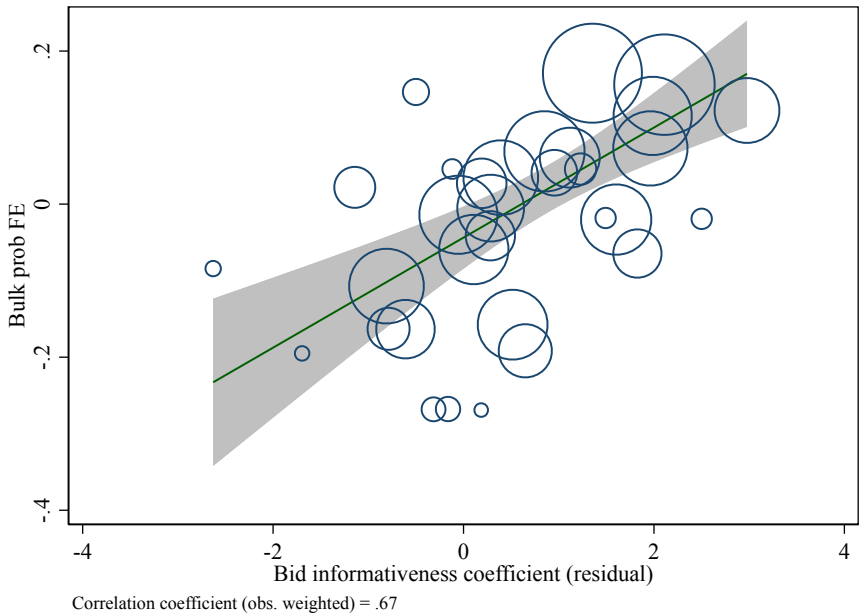
- **Bidder survival FE:** Measure of bank "productivity", centered at zero.

$$1(T_i > T) = Z_i\beta + \text{Fixed effects} + \omega_j 1(\text{Bank } j \text{ wins}) + \epsilon$$

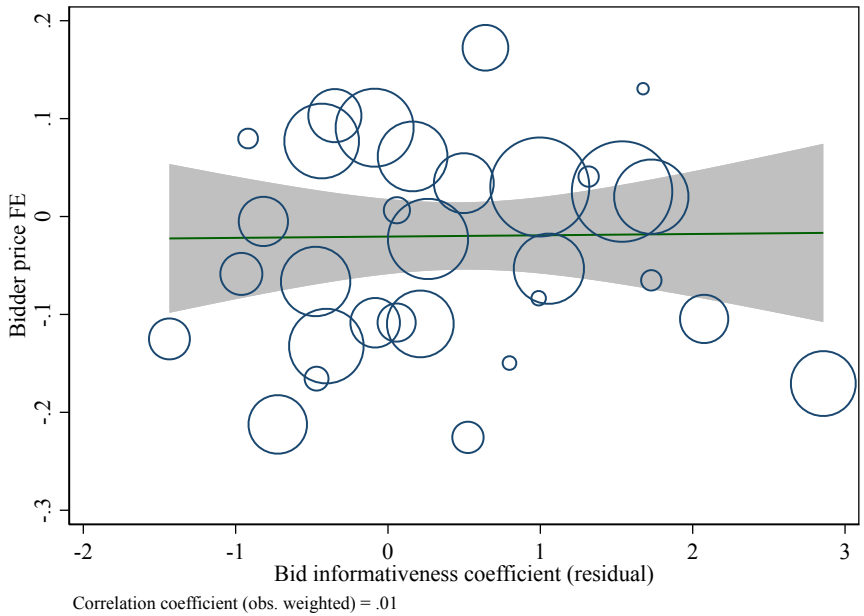


Information quality and Bids

Information quality
and propensity to use bulk bids



Information quality
and Winning bids

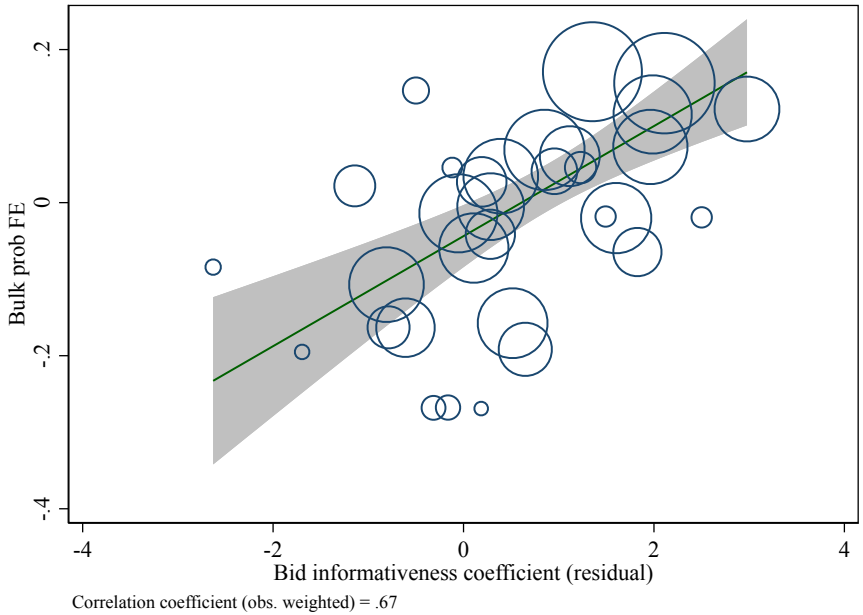


$$\text{Left: } 1(\text{Bulk bid})_{ij} = Z_i\beta + \text{Fixed effects} + \text{Bidder FE} + \epsilon$$

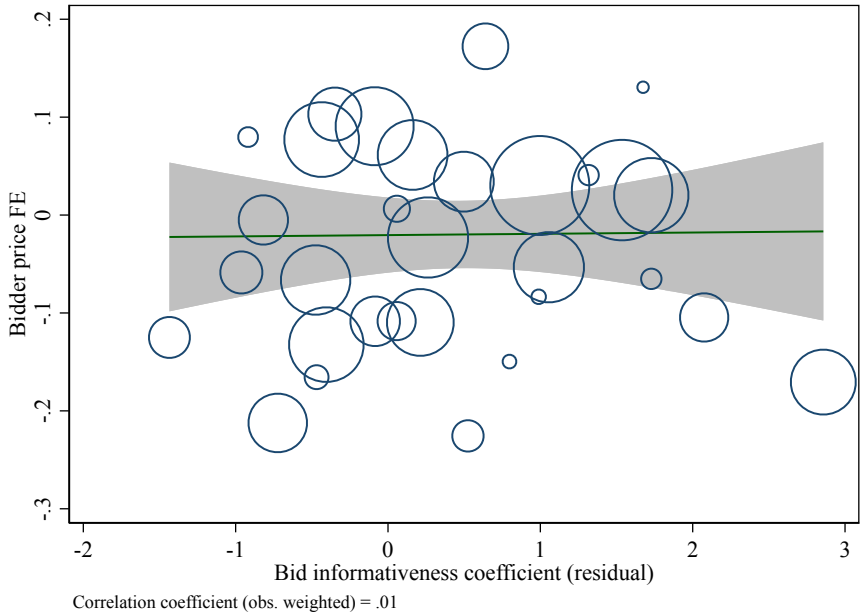
$$\text{Right: Win. bid}_i = Z_i\beta + \text{Fixed effects} + \omega_j 1(\text{Bank } j \text{ wins}) + \epsilon$$

Information quality and Bids (cont.)

Information quality
and propensity to use bulk bids



Information quality
and Winning bids

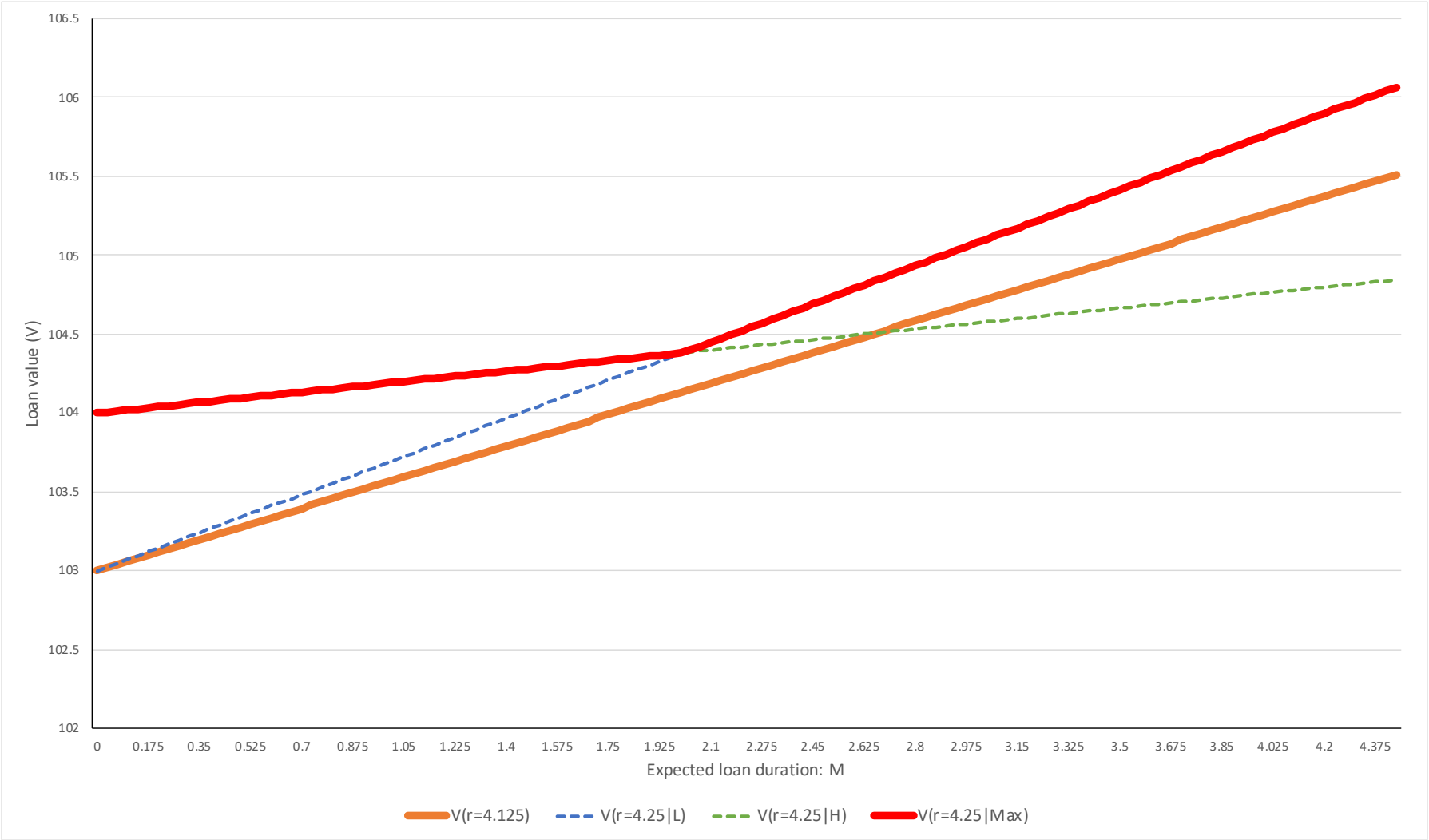


Takeaway

- *Informed bidders more likely to submit a bulk bid, less informed more likely to submit lock*
- *Less informed bidders are subject to the Winner's Curse.*

What is the effect of the coupon-choice option on bids?

Illustration: Value function for two note-rates



What is the effect of the coupon-choice option on bids?

- Loans placed in *high-coupons* MBS are adversely-selected
  - Coupon-choice option increases WTP of informed lenders
- Heterogeneity in coupon decisions *within* auctions:
  - Banks have different beliefs about $\bar{M}_i$
  - Asymmetries: (i) information quality, (ii) ability to customize securities

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- Heterogeneity in coupon decisions *within* auctions:
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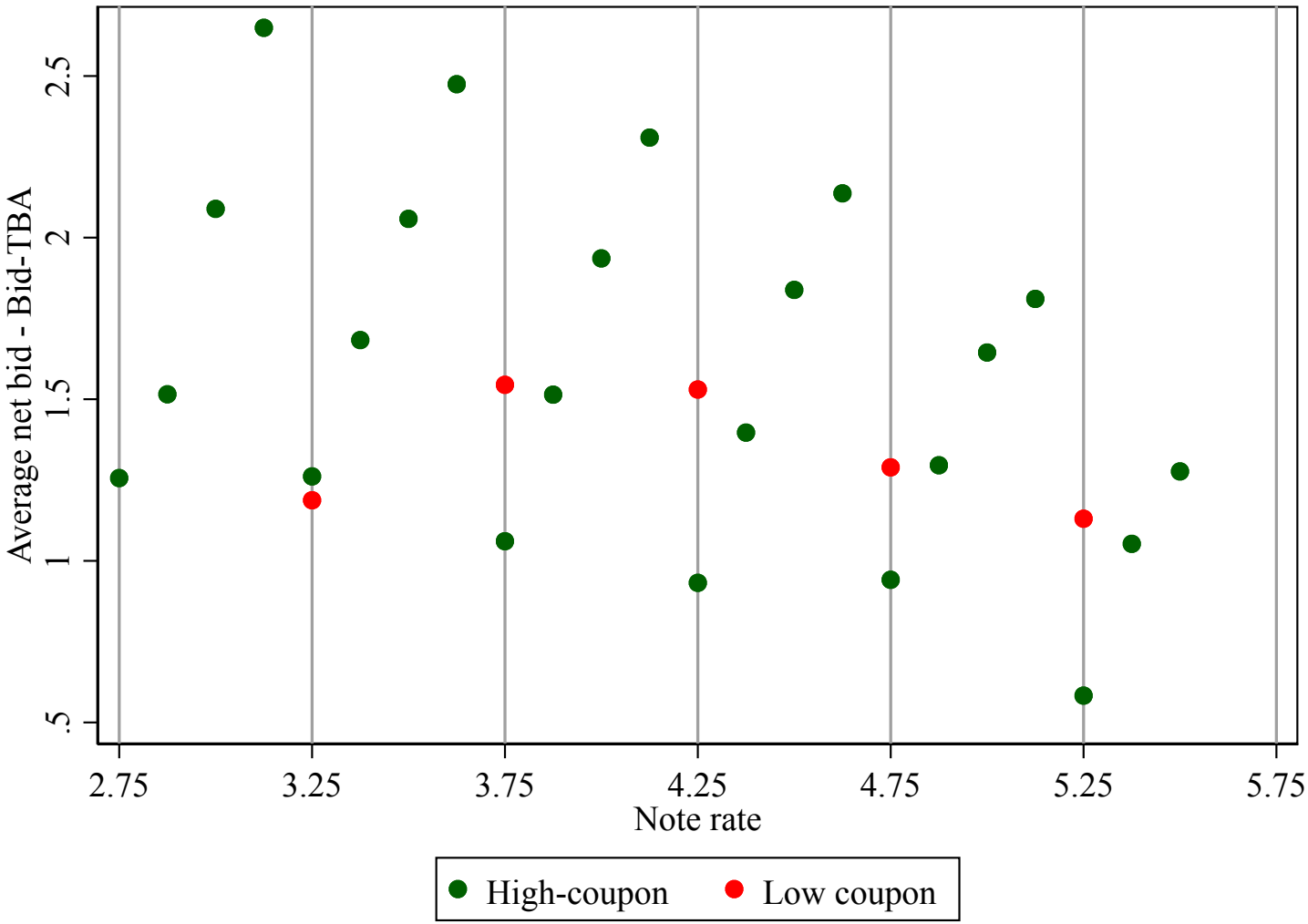
  - Asymmetries: (i) information quality, (ii) ability to customize securities
- **Implication for bids:**
  - Bids do not (fully) reflect $\uparrow$ in value created by adverse-selection
  - Larger markups for loans with a coupon-choice option
    - ★ Winner's Curse: Type-H lenders adjust bid down
    - ★ Type-L lenders have market-power (e.g. liquidity advantage)

Are winning bids consistent with adverse-selection?

Dot = Average net-bid conditional on Z_i



Distribution of coupons and performance

What is the effect of security customization on bid dispersion and levels?

Regression: $Y_i = \beta 1(\text{Coupon-choice}) + g(r) + Z_i\gamma + \text{FE} + \epsilon_i$

VARIABLES	(1) Bids	(2) Dispersion	(3) Within auction $P(10)$	(4) Within auction $P(90)$	(5) Quantile regression $P(10)$	(6) Quantile regression $P(90)$
1(Coupon-choice)	-0.34	0.060	-0.48	-0.26	-0.53	-0.33
	(0.0074)	(0.0028)	(0.011)	(0.0083)	(0)	(0)
Observations	892,516	80,453	80,470	80,470	892,516	892,516
Dep. variable	104	0.56	103	103	104	104

Takeaway

Loans with a coupon-choice choice exhibits:

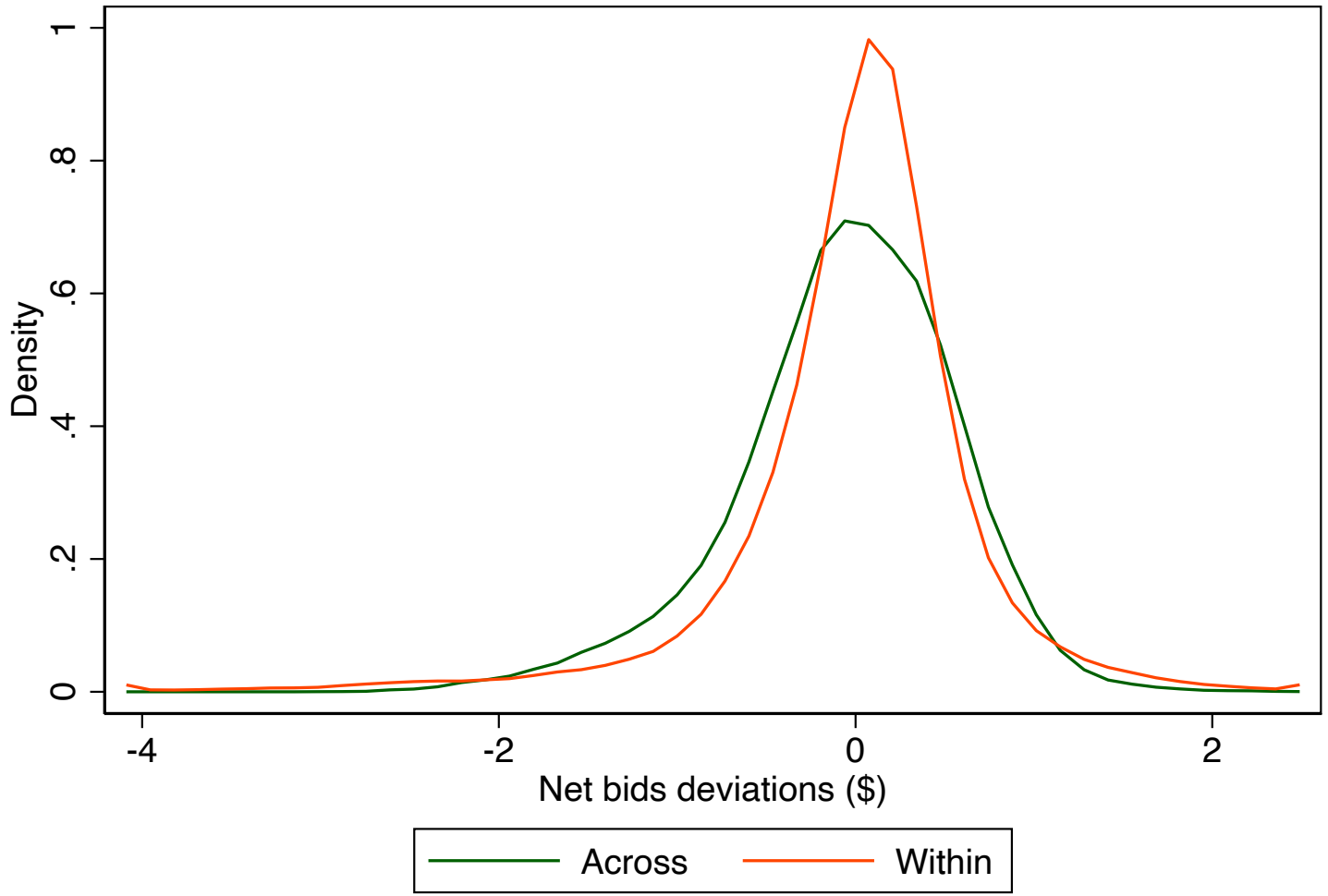
- *More dispersion in values and higher markups*
- *Winner's Curse: Type-H lenders lower bids for coupon-choice loans*

Conclusion

- Main Results
  - Banks value loan duration, and price it more efficiently in the auction than in the posted price market.
  - Auction is a common value auction with differentially informed bidders.
  - Asymmetric informationleads to adverse selection in the MBS market.
  - Ability to customize securities increases market-power in the wholesale market
- To Do
  - Adverse selection in wholesale market: Do originators sell higher duration loans in MBS market, lower duration loans in wholesale market?
  - Impact of the auction on borrowing costs: how much of the gain is passed on to borrower?

APPENDIX

Bid dispersion: Within and across auctions



Across auction std-dev: .58. Within auction std-dev: .68

Return

Pricing of Risk Attributes

Regression: $Y_i = Z_i\beta + \text{Date} \times \text{Rate} + \text{County} + \text{Seller} + \epsilon_i$

VARIABLES	(1) Survival (12m)	(2) Bulk bid	(3) Lock price
Loan (/1000)	-15.1*	-0.20*	0.36*
	(0.77)	(0.011)	(0.012)
Loan-sq. (/1000)	1.14*	0.016*	-0.061*
	(0.14)	(0.0023)	(0.0021)
1(Purchase)	3.88*	0.056*	0.072*
	(0.65)	(0.0051)	(0.0077)
LTV	21.3*	-0.054*	0.087*
	(3.18)	(0.026)	(0.036)
FICO	-53.3*	5.27*	6.85*
	(3.86)	(0.036)	(0.052)
1(FHA)	8.02*	0.26*	0.32*
	(0.42)	(0.0035)	(0.0048)
DTI: 50-60	-2.50*	-0.045*	0.0020
	(0.66)	(0.0056)	(0.0078)

- Bulk: Hedonic prices match main survival attributes (expt. FICO)
- Lock prices not as well, but fit is much better, $\approx$ deterministic.

Return

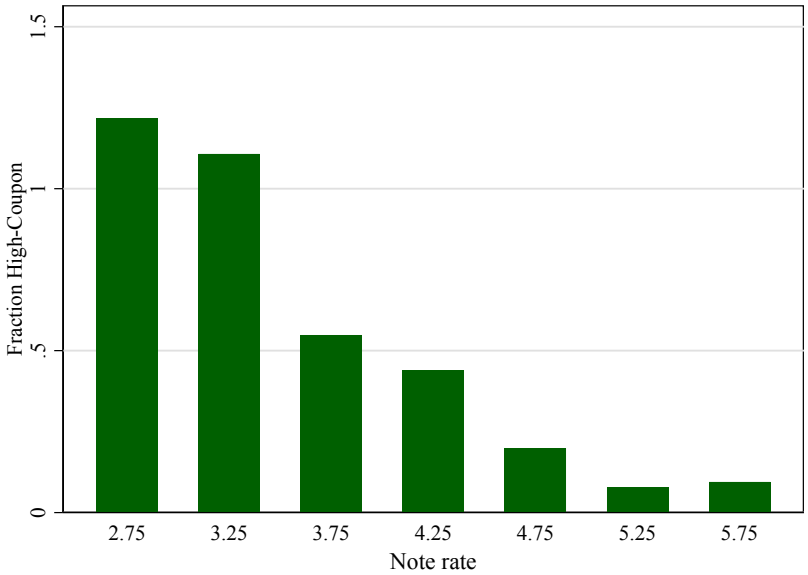
Control Variables

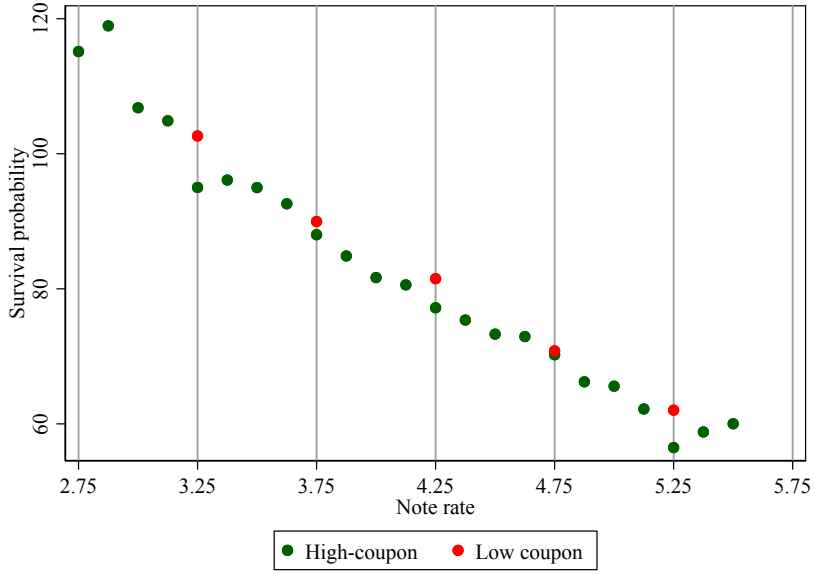
- Baseline specifications: Period x Note-rate fixed effects
  - MBS sample: Issuance month
  - Auction sample: Auction date
- Loan attributes:
  - Loan size, FICO, LTV, Refi/Purchase, Income (auction), DTI, Agency (VA/FHA), Zip-code house value
  - Geography: County (Auction), State (MBS)
- Origination channel:
  - Auction: Originator (Seller) fixed-effects
  - MBS: Channel, Issuer fixed-effects

Return

Coupon choice and average survival

Dot = Average 12-month survival conditional on Z_i





- **Sample:** Auctions for loans pooled in multi-issuer securities

Return