AVM versus Appraisal-Based Underwriting in Refinance Mortgages: The Trade-off Between Noise and Bias.

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Introduction

Motivation

- AVM vs. appraisal - a perennial debate.
- Anchoring bias in appraisals well known for purchases.
  - However -refinance have *no purchase price*.
- Prior studies evaluate appraisals with
  - AVM
  - Repeat Sales Index

This paper's approach:

1. Examine with respect to *private initial estimate by borrower/loan officer.*
2. Evaluate information value using *risk rank ordering ability*.

Preview of Results - I

First order

1. 7.5% of appraisals "hit the mark."
   - Cannot be explained by coincidence, prior transaction anchoring, or rounding.
   - More likely at high LTV, at LTV notch points, and for overvalued initial estimates.
2. Concentrated among *appraisers.*
3. Valuation **information value:**
   - Roughly the same for loans with anchoring bias.
   - Slightly degraded for loans valued by *appraisers* that anchor.

Preview of Results - II

Second order

1. **Consumer side:** Hitting the mark not *associated* with higher likelihood of getting approved or closing loan.
2. **Appraiser Side:** Hitting the mark not *associated* with higher work volume.

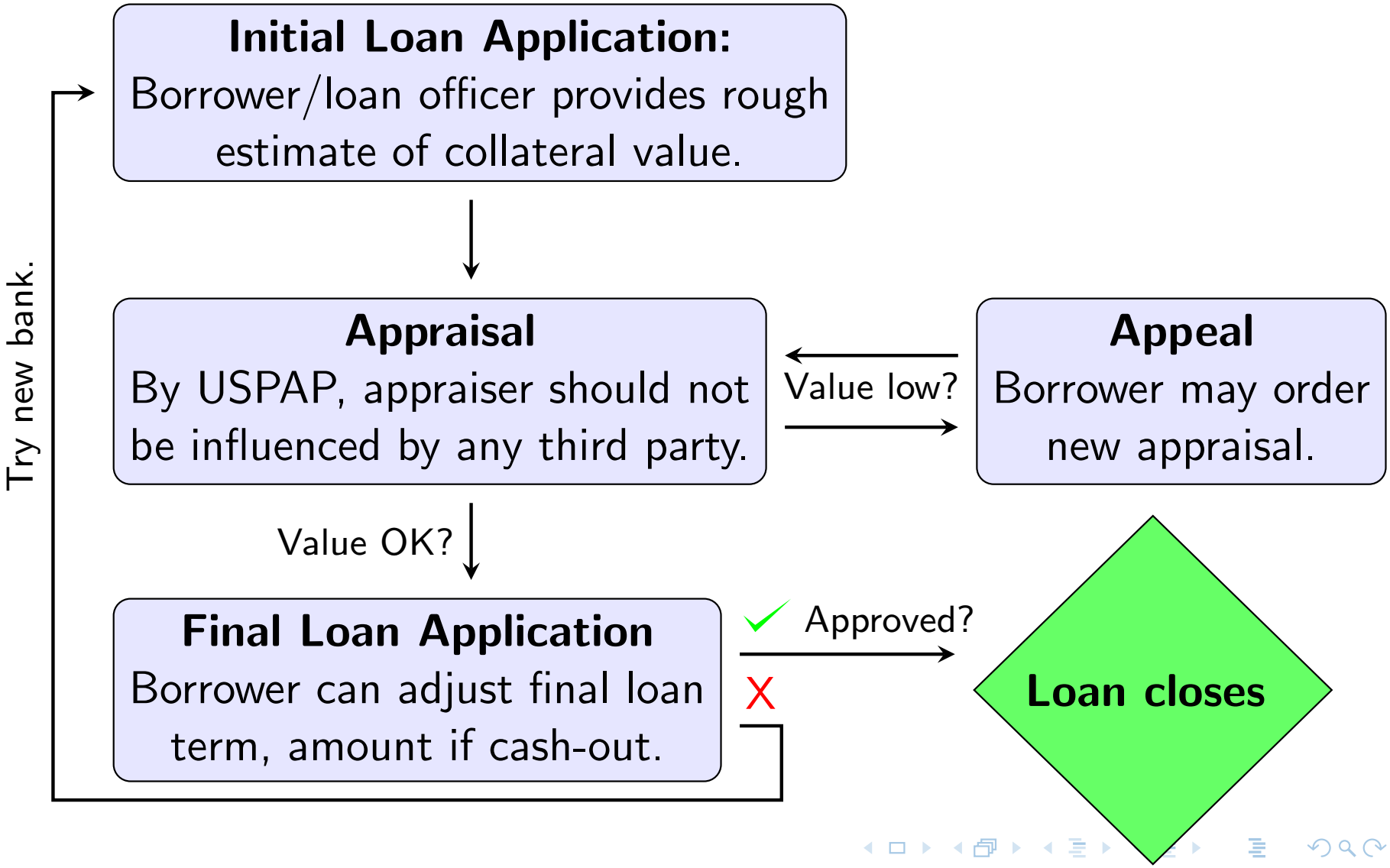
Data

- **Universe** of GSE's appraisals from 2013-2017. 2 million unique casefiles.
- Full URAR appraisals submitted in Uniform Collateral Data Portal (UCDP)
- Includes associated loan application information
- For loans that closed, subsequent loan performance available.
- Focus on Limited Cash-Out (LCOR).

Unique features

- Appraisals are included even if loan *is not closed.*
- Appraisals are associated with a unique *appraiser* ID.
- Each casefile has "initial estimate of value" pre-appraisal.
- Each casefile contains both an appraisal and AVM value.

The refinance appraisal process



Example of appraisal independence guidelines.

Fannie Mae Appraisal Independence Guidelines

No ...agent of the Seller ... shall influence or attempt to influence the development, reporting, result, or review of an appraisal ... including but not limited to:

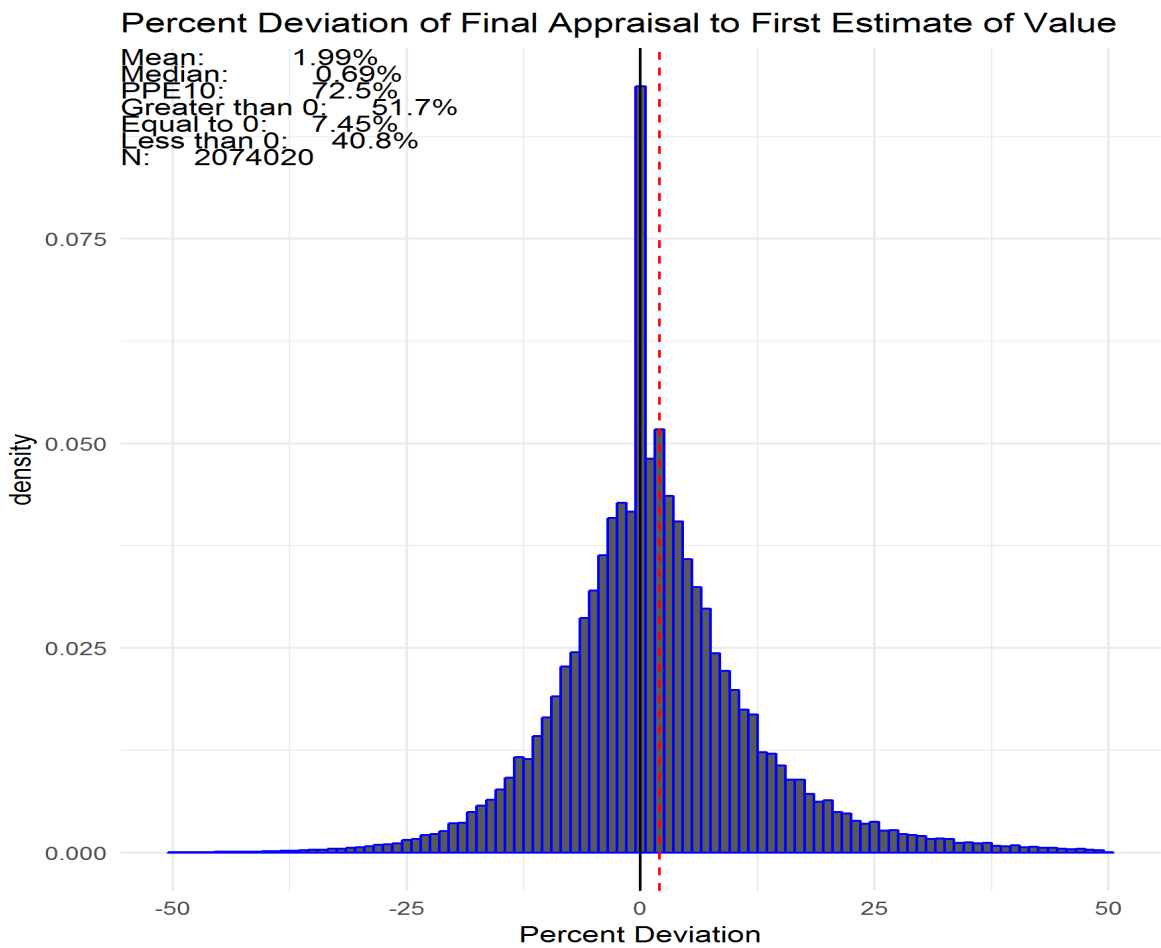
- *Requesting that an appraiser provide an estimated, predetermined, or desired valuation in an appraisal report prior to the completion of the appraisal report, or requesting that an appraiser provide estimated values or comparable sales at any time prior to the appraiser's completion of an appraisal report;*
- *Withholding or threatening to withhold future business for an appraiser, or demoting or terminating or threatening to demote or terminate an appraiser;*

Extent of "hitting the mark"

- First estimate *should not influence valuation.*
- *But* 7.5% hit the mark.

Why?

- Bias ✓
- Rounding X
- Prior transaction anchoring. X



Note: Restricted to Limited Cash-Out Refinance.

Refi LTV Dynamics

What does valuation affect in underwriting?

Answer

LTV

- Loan cost
- Loan approval
- Borrower closing rates.

Initial loan app LTV distribution.

- Initial $\frac{Loan}{Value}$ is set strategically.

Loan

- Timing of refinance
- Cash-out (less of \$2000 and 2% for LCOR)

Valuation

- Initial Estimate

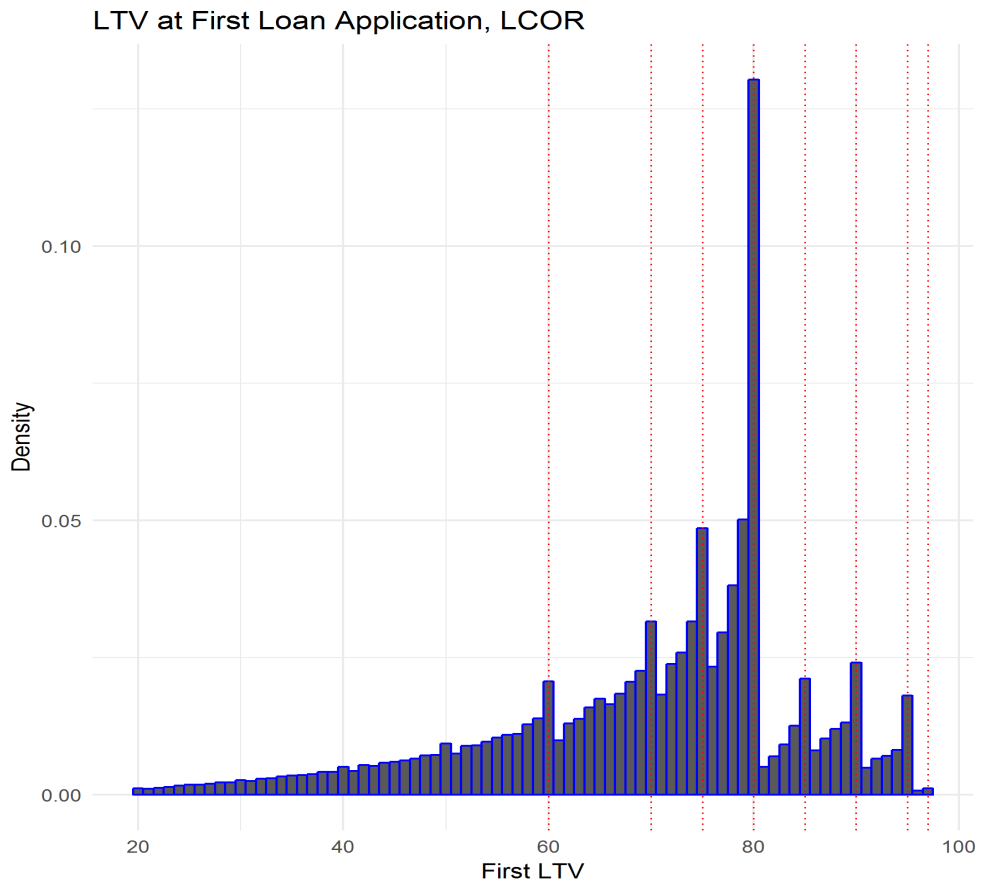
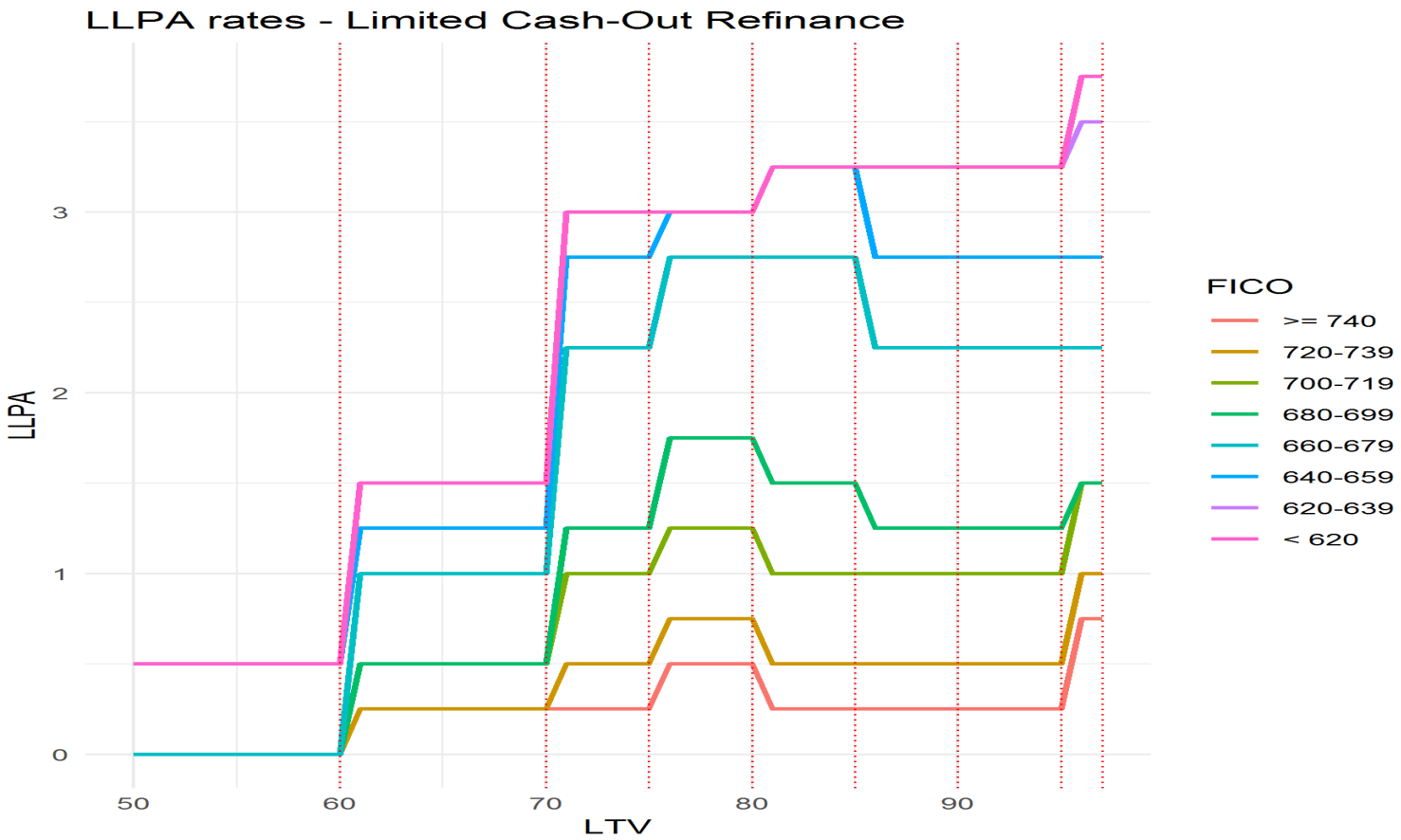


Figure: Red dotted lines indicate LTV buckets.

Is loan cost the driver? LLPA and LTV.

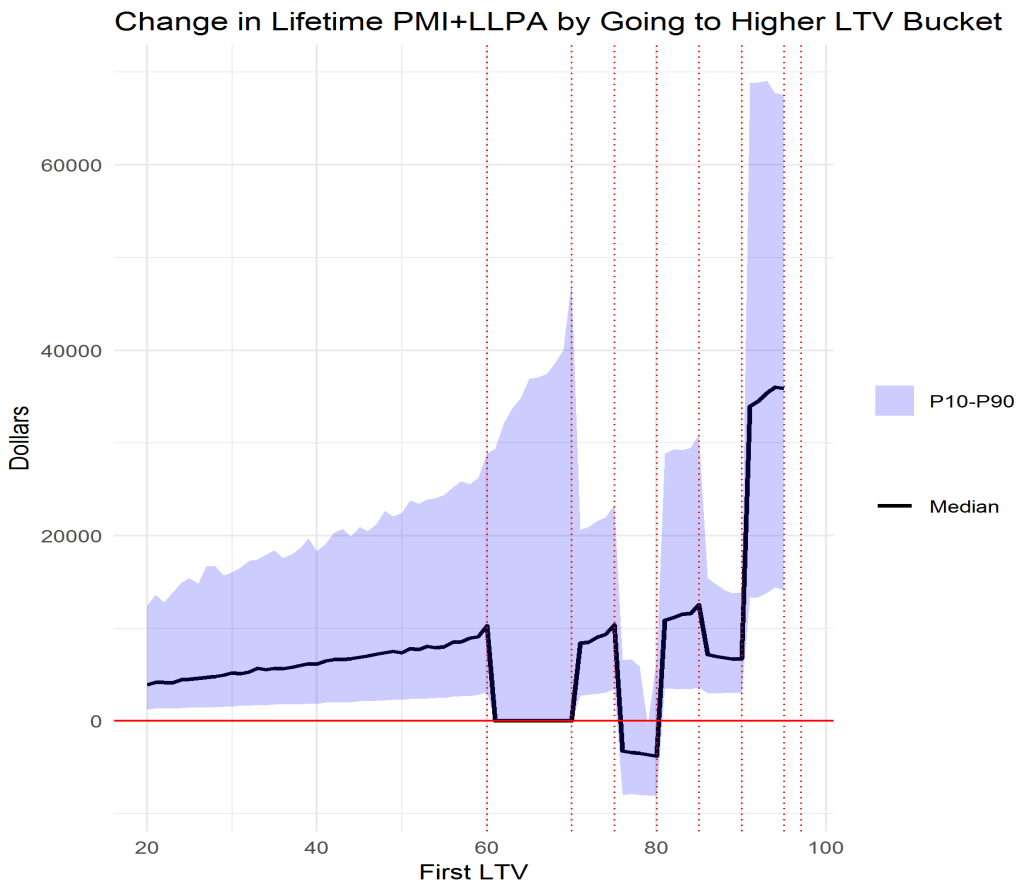


Note: Red dotted lines indicate LTV buckets.

Source: Fannie Mae LLPA Tables..

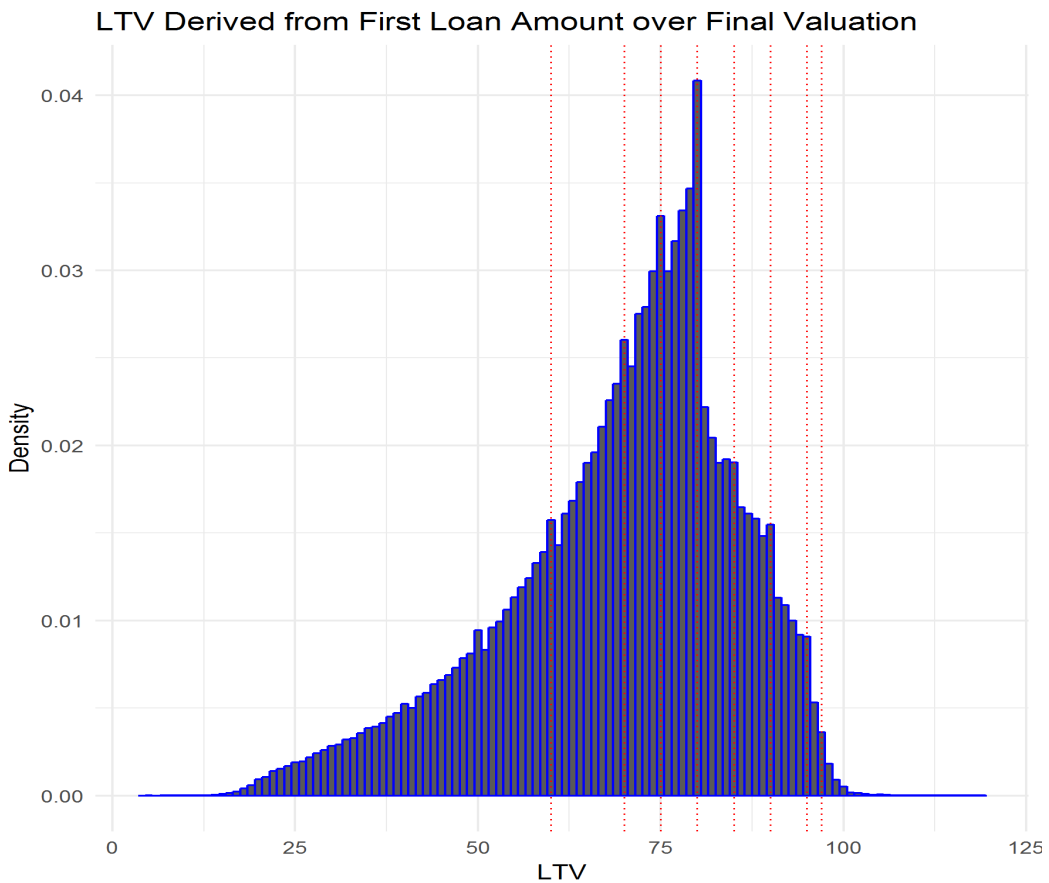
Cost Simulation - What if I fall into higher LTV bucket than initial valuation?

- **Puzzle:** Most borrowers would have *lower* costs going into the higher bucket in $75 - 80$ range..
- *Note:* assumes no default/prepay.
  - Shape of graph robust to 2, 4, and 7-year loan cost.

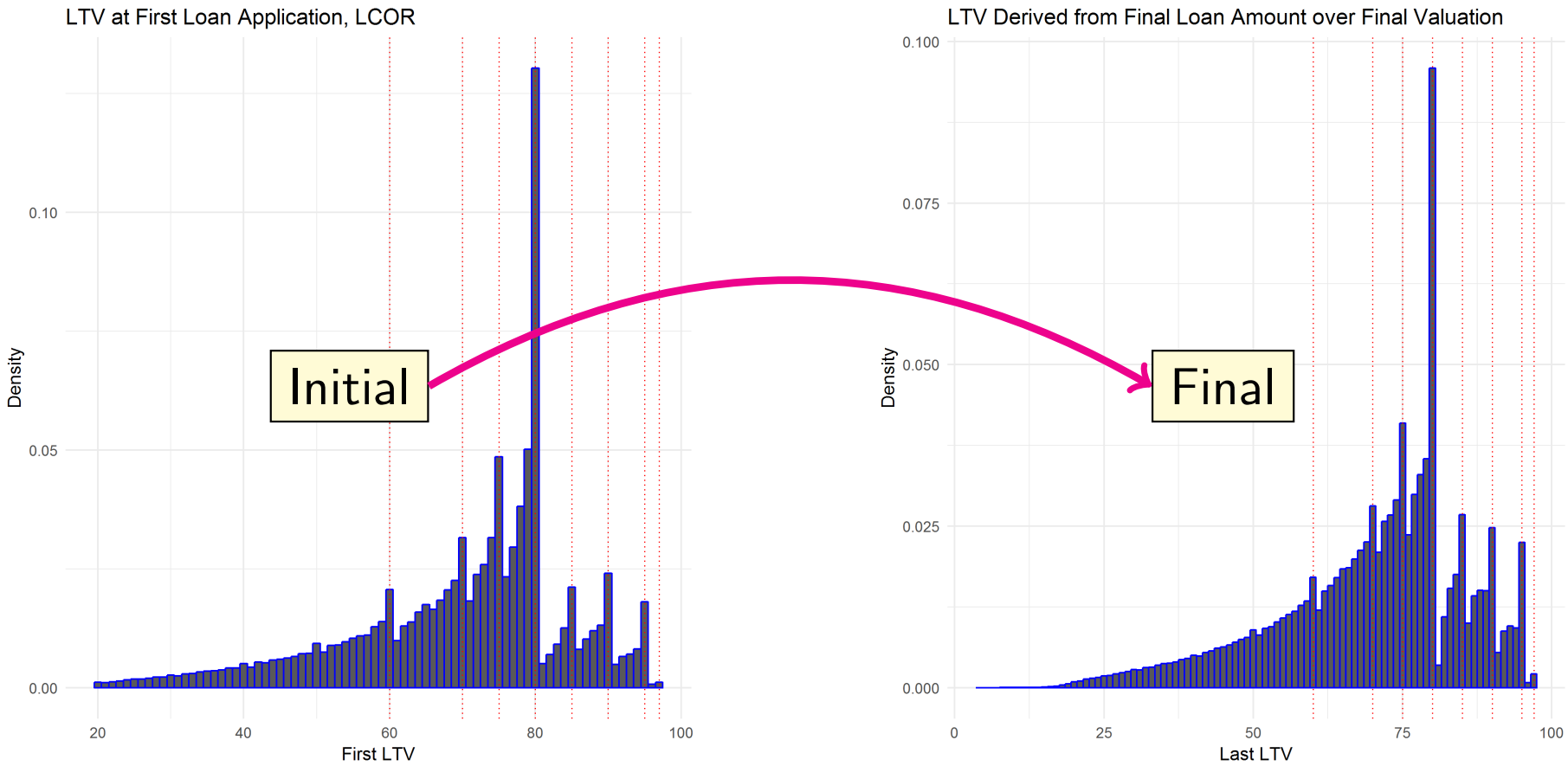


Post-appraisal LTV distribution - before loan amount changes.

- For most borrowers - low appraisal *does* increase costs
- Post appraisal, LTV no longer bunches.
- However, borrowers subsequently *adjust.*



Final LTV distribution - borrowers adjust back



Why Hit the Mark?

Loan approval over final LTV

- Hitting the mark coefficient: $-.59^{***}$. Does not obviously help approval.
- Small decreases in approval rate above notch points.
- Scale: approval around 90%, decrease in log odds of $-.5$ deceases this to 85%
- **Does not explain whole story.**

Other coefficients

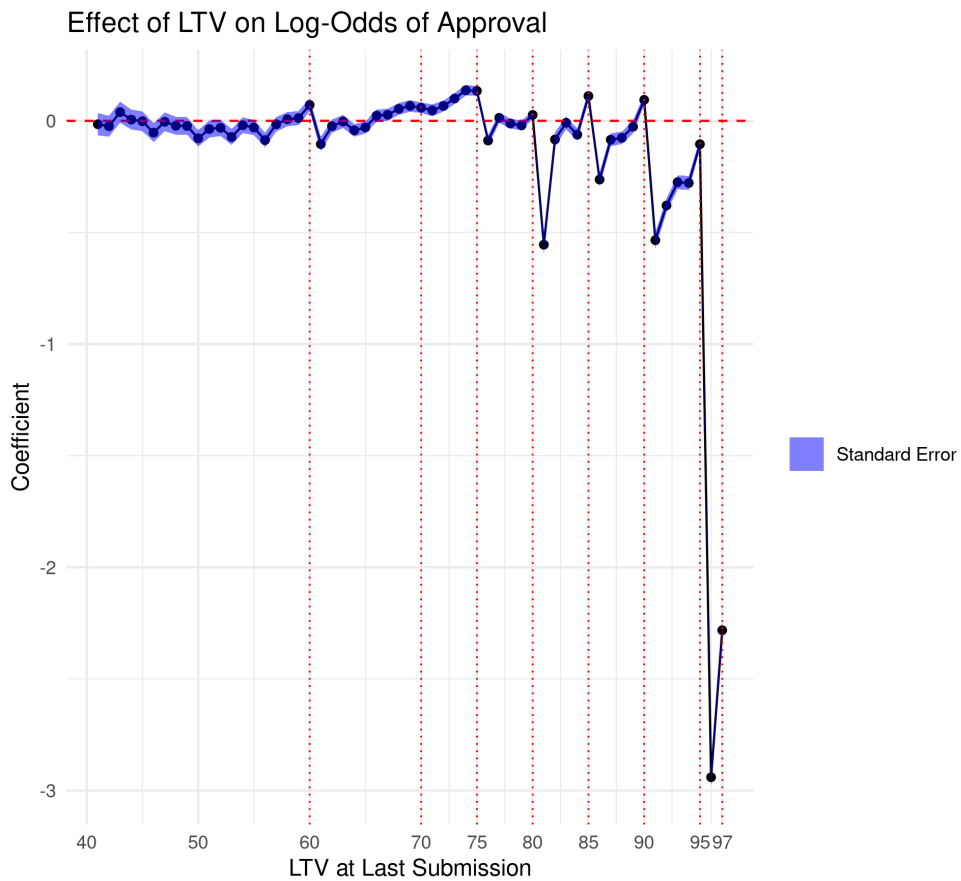


Figure: LTV coefficients from approval regression, controlling for observable loan/collateral factors.

Borrowers closing

- In purchases, low appraisal has been shown to lead to borrower withdrawal.
- Hitting the mark coefficient also negative: $-.26^{***}$.
- Both closure and approval are less likely at high LTV.

Other coefficients

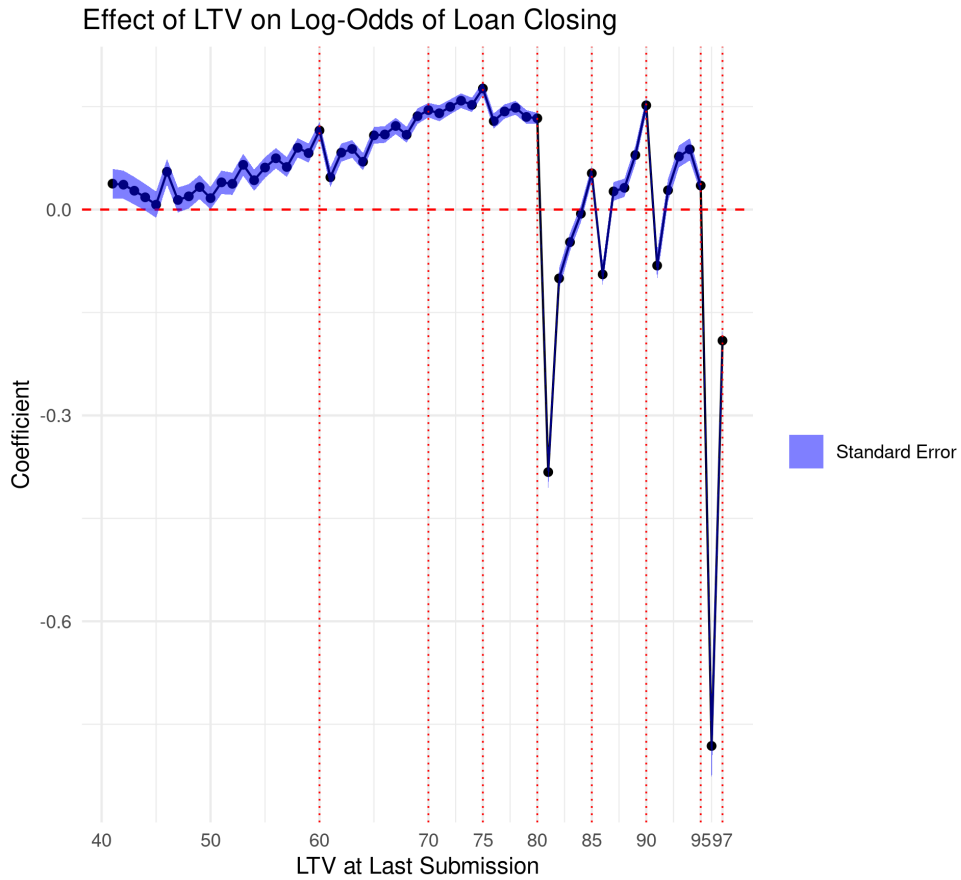


Figure: LTV coefficients from closure regression, controlling for observable loan/collateral factors.

What factors predict "hitting the mark?"

- Definitively goes up at higher LTVs.
- Significant and positive effect of potential loan cost increase.
  - Effect much higher for PMI than LLPA.
- Appraiser work volume insignificant (See Tzioumis (16)).

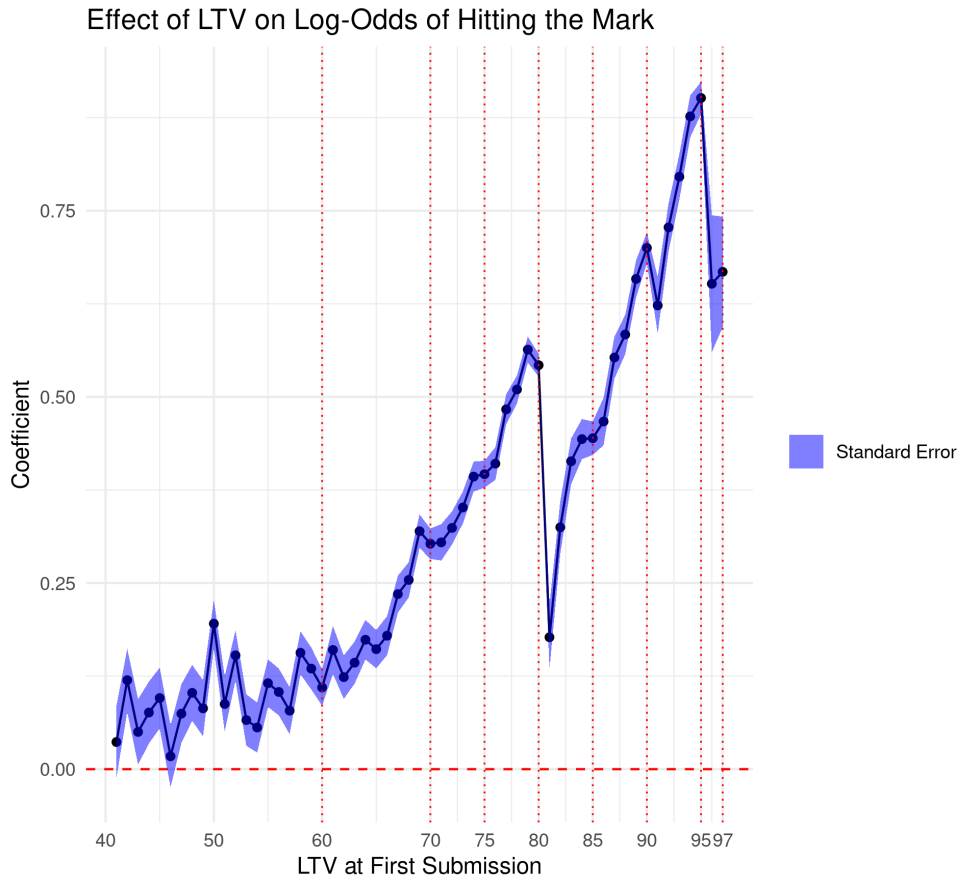


Figure: LTV coefficients from closure regression, controlling for observable loan/collateral factors.

Select "Hitting the Mark" regressions

	Dependent Variable: Hitting the Mark				
	(1)	**(2)**	**(3)**	**(4)**	**(7)**
Intercept	**-3.14**	**-3.21**	**-2.21**	**-2.47**	**-2.31**
	(1.07)**	(1.07)**	(1.18e-01)***	(1.20e-01)***	(1.20e-01) ***
Δ Loan life cost	**3.30e-06**	**4.68e-06**	**4.40e-06**		
↑ LTV buck.	(1.34e-07)***	(1.31e-07)***	(1.32e-07)***		
76-80 LTV buck.		**2.63e-01**	**2.65e-01**		
		(5.95e-03)***	(5.97 e-03)***		
ΔLLPA Cost				**4.00e-06**	
↑ LTV buck.			(1.63 e-07)***		
Δ PMI Cost				**2.34e-04**	
↑ LTV buck.				(7.21e-05)***	
Δ First			**1.26e-02**	**1.24e-02**	**1.40e-02**
Est. to AVM			(1.88e-04)***	(1.89e-04)***	(1.93e-04)***
Loan Term				**8.97e-04**	**5.31e-02**
				(3.45e-05)***	(1.30e-02)***
App. Work Vol.					5.93e-05
					(2.39e-05)
FICO Dum.	No	No	No	Yes	Yes
First LTV Dum.	No	No	No	*See figure*	...
Somer's D	0.081	0.107	0.144	0.155	0.171

Figure: Regressions are logistic functional form

Are appraisers homogenous? Appraiser-specific effects

- Appraisal volume highly concentrated **(0.61 Gini)**
- "Hitting the mark" highly concentrated **(0.61 Gini)**
  - 40% of appraisers never hit the mark.
- 'Above the mark" not concentrated. **(0.24 Gini)**

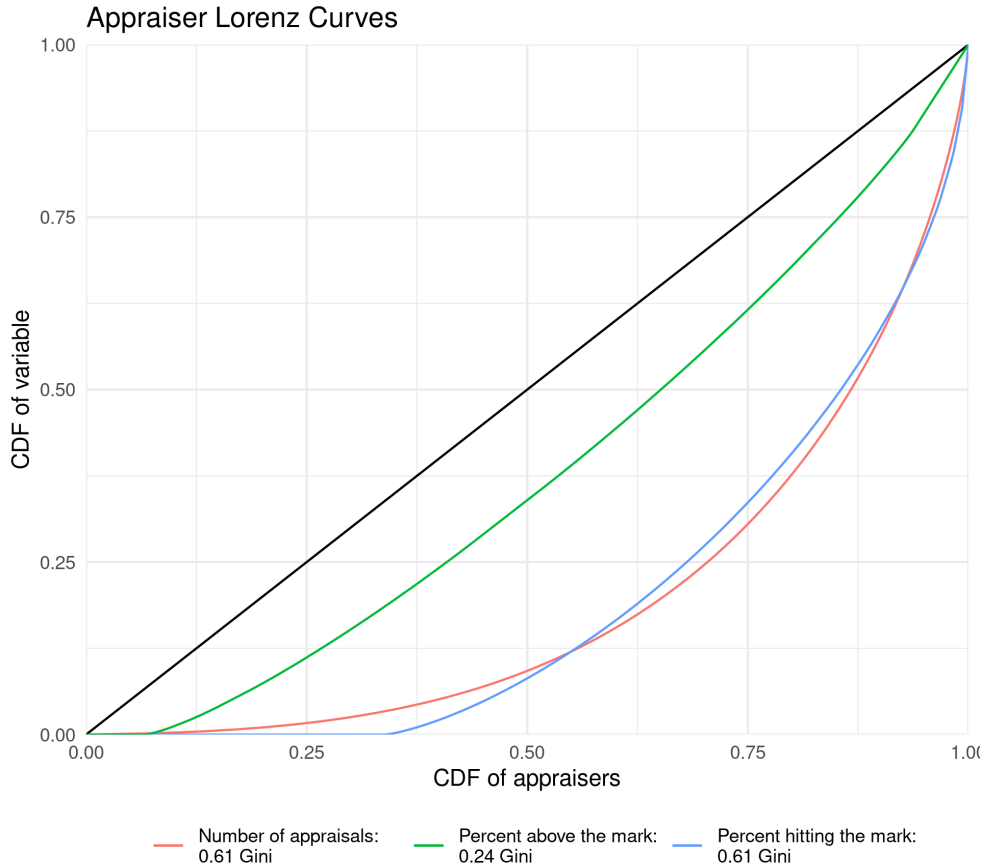


Figure: LTV coefficients from closure regression, controlling for observable loan/collateral factors.

Consequences of Hitting the Mark

So what? The consequences of hitting the mark in underwriting

Approach:

Examine the consequences in terms of *risk rank ordering*.

- Estimate early-stage delinquency risk-model predicting 90 DPD in first 2 years on book.
  - Model includes all typical loan-level factors used in credit scorecards (LTV most important factor).
  - Less data and 4 year performance window yields similar results.
- Conduct counterfactuals (on holdout set):
  - Evaluate switching out appraisal-based LTV vs AVM-based LTV on risk-rank ordering.
  - Evaluate re-estimating model with LTV from appraisal vs AVM on risk-rank ordering.
  - Swap-set analysis using simulated cut-offs.

Swapping LTVs - Effect on Risk-Rank Ordering

	Holdout Somer's D	
Valuation method	**Appraisal LTV Model**	**AVM LTV Model**
Appraisal LTV	0.6823	0.6783
AVM LTV (entire set)	0.6772	0.6757
AVM LTV (hit the mark)	0.6810	0.6777
AVM LTV (notch points)	0.6813	0.6776
AVM LTV (high LTV)	0.6816	0.6781
AVM LTV (biased appraisers)	0.6828	0.6823

Figure: Valuation method only used on the *scored* population, with the model being estimated on either AVM LTV or Appraisal LTV. Appraisal LTV is used as default for scoring, with AVM LTV used in certain subsets as indicated.

Swap-Set Analysis - Effect on Losses

- Limited by small number of foreclosures in the sample (130).

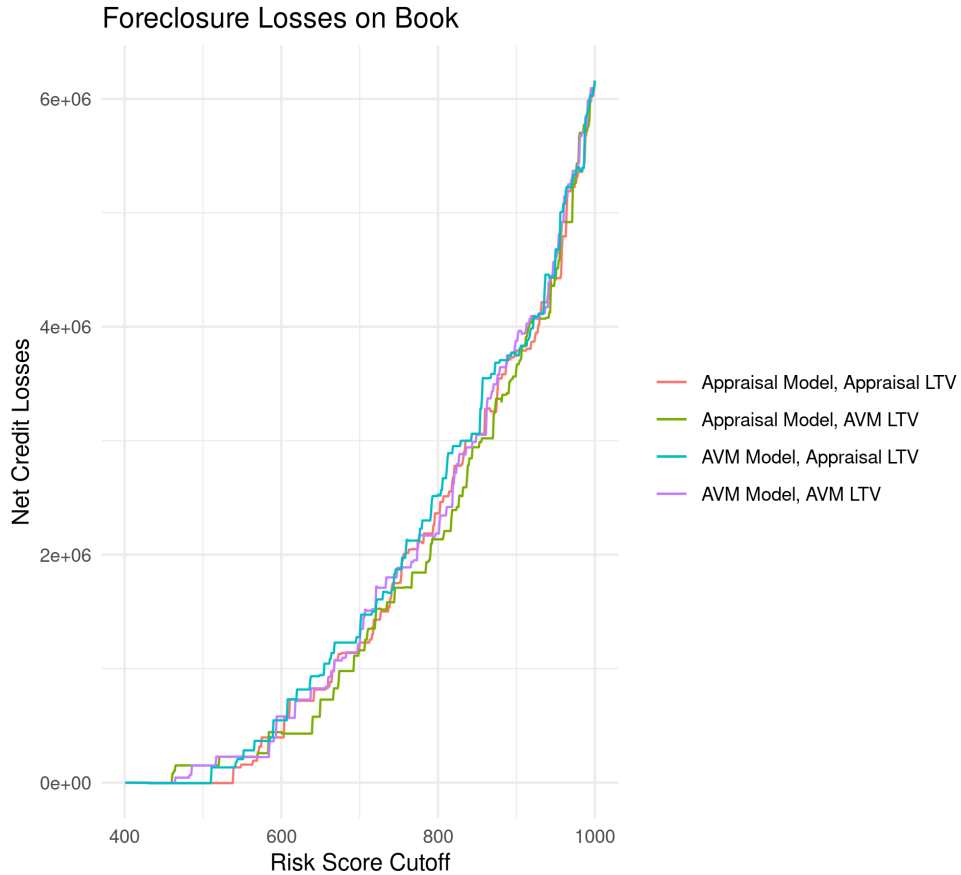


Figure: High risk score implies higher probability of bad event. Portfolio with the an x cut-off includes all customers with risk score *at or below* x and leaves out customers with risk score *above* x. Based on total of 123 foreclosures observed within 2 year performance window in this sample.

Conclusions

- We examine refinance appraisal vs AVM from the lense of
  - Anchoring bias
  - Risk-rank ordering properties
- Appraisers are not homogenous - we find significant *appraiser*-specific effects.
- However, despite significantly different distributions, information value of the two estimates is very similar.

Appendix

Rounding and Hitting the Mark

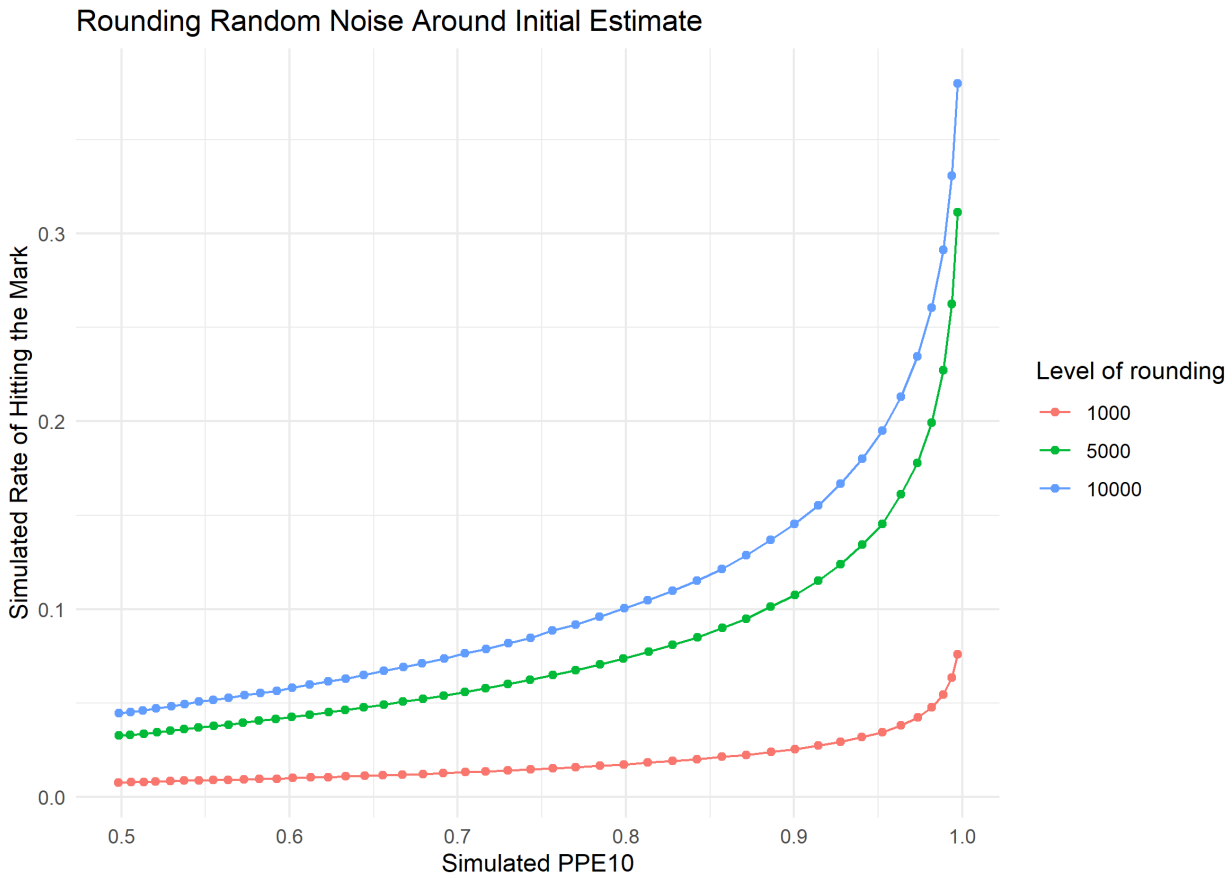
Level of Rounding (First Estimate)	Hitting the Mark	
	Rounded	Non-rounded
Multiple of 100	7.57%	1.58%
Multiple of 1,000	7.72%	1.70%
Multiple of 5,000	8.36%	3.48%
Multiple of 10,000	8.43%	6.21%
Multiple of 50,000	8.30%	7.15%

Figure: **Hitting the Mark Between Appraisals with Rounded and Non-rounded Initial Estimates.**

Note: Restricted to limited cash-out refinances. Rates of hitting the mark were calculated for appraisals where the initial estimate was rounded to various common factors, and contrasted with the rate of hitting the mark with non-rounded initial estimates.

Rounding and Hitting the Mark - Simulation Experiment

- **X axis** - variance of initial noise around estimate.
- **Y axis** - rate of hitting the mark post rounding.



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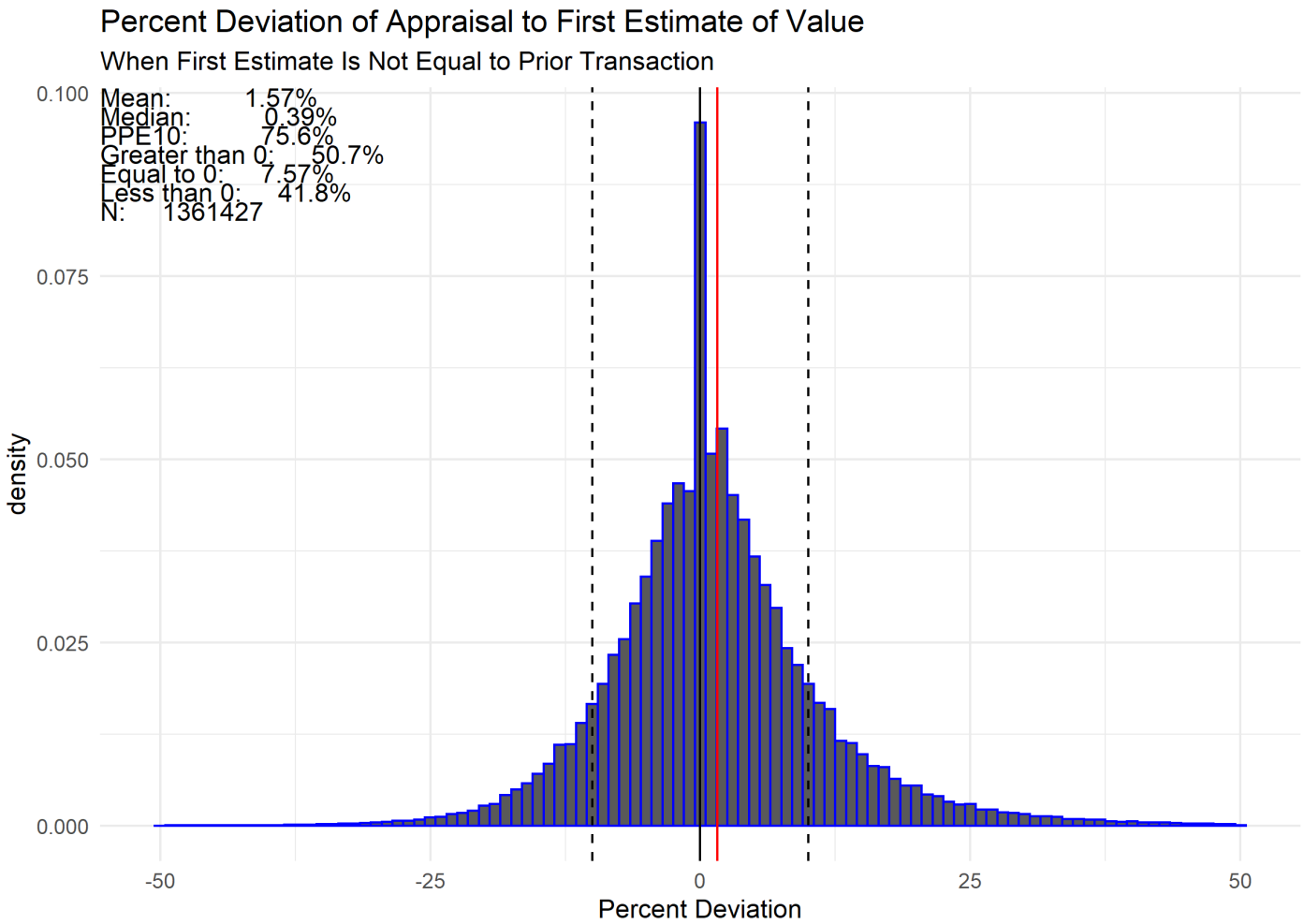
Prior Transactions and Anchoring



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Note: Restricted to Limited Cash-Out Refinance.

Loan Approval/Borrower Closure Regressions

	Approval	Closing Given Approval
Intercept	**2.96**	**-2.12e-01**
	*(2.57e-02)***	*(1.29e-02)***
Final Loan Term	**-1.36e-03**	**-3.81e-04**
	*(4.13e-05)***	*(1.73e-05)***
Pc. Dev. of First Estimate to AVM	**-8.64e-04**	**-3.14e-03**
	*(3.01e-04)***	*(1.43e-04)***
Pc. Dev. of Final Appraisal to First Estimate	**1.95e-02**	**5.47e-03**
	*(3.82e-04)***	*(1.82e-04)***
Pc. Dev. of First estimate to AVM * Pc. Dev . of Final Appraisal to First Estimate	**2.43e-04**	**1.15e-04**
	*(6.36e-06)***	*(4.39e-06)***
Pc. Dev. of Final Loan Amount to First Loan Amount	**-1.17e-02**	**-2.98e-03**
	*(6.18e-04)***	*(3.05e-04)***
Dummy for No Change in Loan Amount Between First and Last Submission.	**-2.23e-01**	-3.07e-03
	*(6.54e-03)***	*(3.04e-03)*
Dummy for Hitting the Mark	**-5.97e-01**	**-2.64e-01**
	*(9.73e-03)***	*(5.59-03)***
ARM Dummy	**-1.44**	**-6.41**
	*(9.86e-03)***	*(9.04e-01)***
FICO Bucket Dummies	*See paper*	
Dummies for LTV	*See figure*	
Somer's D	0.334	0.143

Figure: Regressions are logistic functional form

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