Collateral Misreporting in the RMBS Market

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▶ Did RMBS sponsors and mortgage originators mislead RMBS investors about collateral values?

- If so, how pervasive was the bias?
- What caused it?
- Were investors hurt?

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▶ Widespread evidence of fraud and misreporting in the RMBS market during the run-up to the financial crisis, culminating in $137+ billion in fines
  ■ Misreported loan characteristics includes second liens, owner-occupancy status, income, and collateral value (Piskorski, Seru, and Witkin 2015, Griffin and Maturana 2016, Jiang, Nelson, and Vytlacil 2014, Agarwal, Ben-David, and Yao 2015, Mian and Sufi 2017)

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- 45% of RMBS loans have overstated appraisals (Griffin and Maturana 2016)
- Appraisal bias is frequently cited in government settlements and private lawsuits

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- 45% of RMBS loans have overstated appraisals (Griffin and Maturana 2016)
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▶ Yet, there remains significant disagreement about the magnitude of appraisal bias, how to identify it, and what caused it (e.g., Demiroglu and James 2016)

Collateral valuation

- Collateral value plays central role in mortgage lending and securitization
  - Primary protection from default and value in case of default
  - Underwriting standards limit LTV ratios, and LTV ratios prominently reported to RMBS investors

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- Collateral valuations rely heavily on appraisals
  - Purchase valuations based on lesser of appraisal and purchase price
    - Protection from overpriced or fraudulent transaction
  - Refinance valuations based entirely on appraisal valuation
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- Automated Valuation Models (AVMs) are an alternative valuation methodology
    - Valuation based on mathematical model
    - Used as a due diligence tool, not reported to investors

Summary of results and contribution

1. Appraisal targeting is widespread in both purchase and refinance loans

2. Appraisal bias understates LTV ratios and default risk

3. Appraisal bias is almost entirely due to intentional inflation as opposed to selection bias

4. Appraisal bias varies significantly across loan officers, mortgage brokers, and appraisers

Data

1. ABSNet Loan
   - Loan-level information on U.S. non-agency securitized mortgages

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3. New Century Financial Corporation internal data
   - Includes purchase prices (which are missing in ABSNet data)
   - Includes both funded loans and unfunded loan applications
   - Identifiers for loan officers, mortgage brokers, and appraisers

Appraisal differences

▶ To estimate appraisal bias we analyze appraisal differences:

$$AD \equiv \frac{Appraisal - AVM}{\frac{1}{2}(Appraisal + AVM)} \tag{1}$$

Summary statistics

| Variables	All loans $N = 5,934,938$		Refinance loans $N = 3,662,156$		Purchase loans $N = 2,272,782$	
	Mean	SD	Mean	SD	Mean	SD
Appraisal bias measures						
Appraisal difference (AD) (%)	4.69	23.2	5.36	24.3	3.62	21.3
AD>0 (d,%)	59.7	-	61.0	-	57.6	-
Loan/borrower characteristics						
Purchase loan (d,%)	38.3	-	-	-	-	-
Loan amount ($000s)	290.3	188.1	291.9	186.0	287.9	191.4
FICO score	673.7	72.7	661.8	75.3	692.9	63.8
LTV (%)	75.9	13.3	72.9	14.3	80.8	9.6
ARM (d,%)	66.7	-	63.4	-	71.9	-
Full documentation (d,%)	44	-	47.2	-	38.7	-
Prepayment penalty (d,%)	37.4	-	38.5	-	35.7	-
Owner occupied (d,%)	86.3	-	89.4	-	81.4	-
Complex (d,%)	11.2	-	13.2	-	8.0	-
Interest rate (%)	6.5	2.2	6.4	2.3	6.6	2.0
Loan performance						
Delinquent 90+ before Sep. 2012 (d,%)	32.9	-	30.2	-	37.3	-
HMDA denial rates (zip code level)						
Denial due to collateral (%)	2.2	1.4	2.5	1.5	1.7	1.2
Denial due to collateral or withdrawal (%)	15.2	5.0	17.5	4.5	11.3	3.1
Denial for any reason (%)	18.9	7.6	21.4	7.5	15.0	5.9
Geographic characteristics (zip code level)						
Average household income ($000s)	54.8	35.9	55.0	36.0	54.4	35.7
Population density (habitants/SqMile)	3,963	5,865	4,062	5,409	3,803.8	6,529.7
House price change 1 year before (%)	13.9	11.2	13.9	11.1	11.2	11.2

Time-series of *AD*

Appraisal bias and credit scores
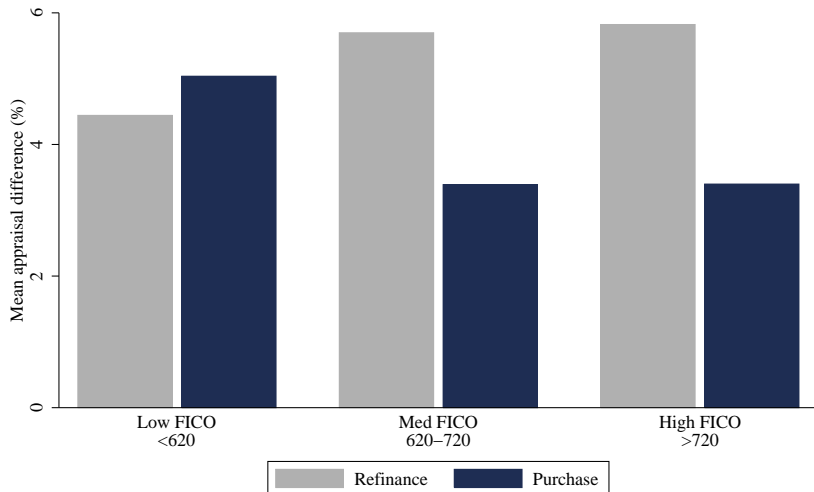
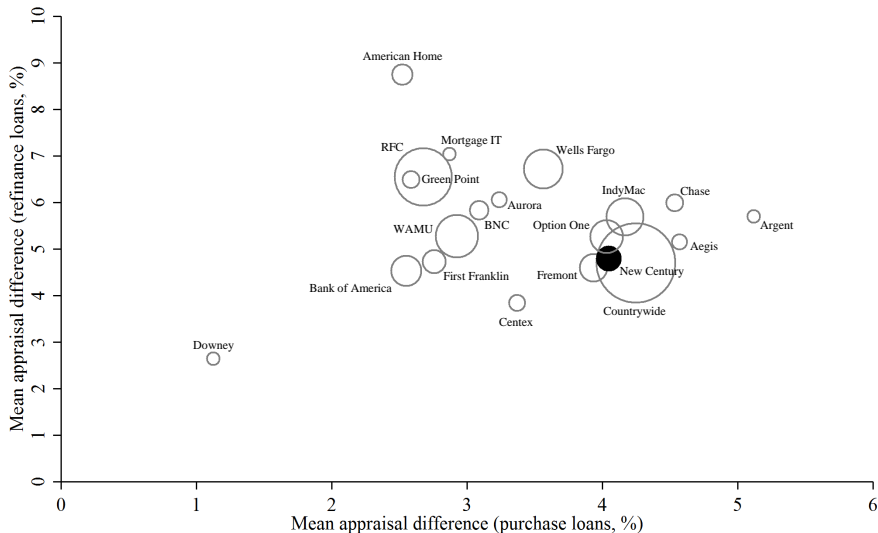# Appraisal bias and home price growth
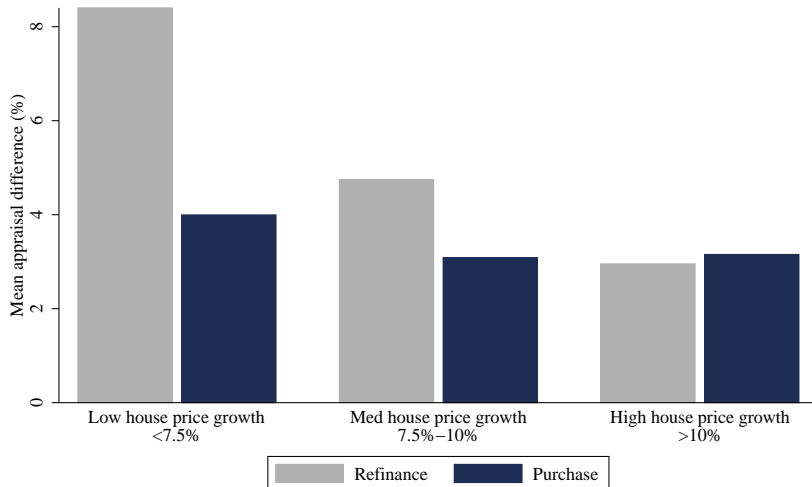
Appraisal bias and home price growth
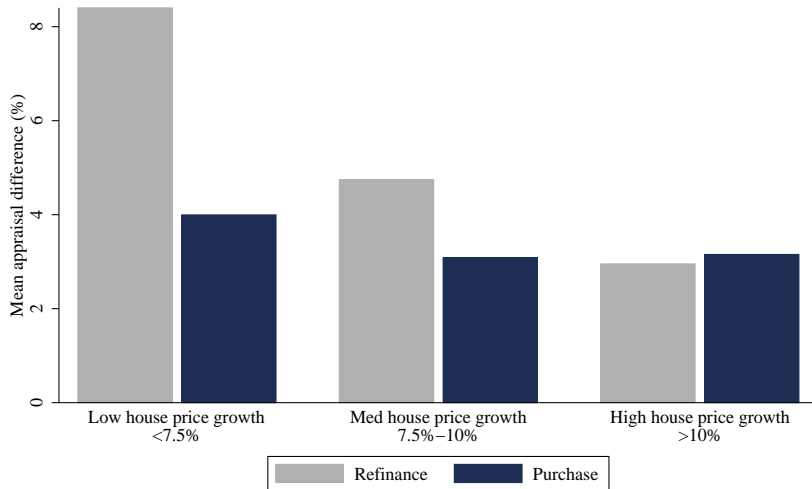
▶ Appraisal bias is also pervasive across loan size, income, population density, home market liquidity, and geography

Additional figures

Appraisal bias by originator

Appraisal targeting

- ▶ Purchase loans
  - Target purchase prices
    - Lower appraisal could jeopardize transaction
    - Higher appraisal has no benefit

- ▶ Refinance loans
  - Target even LTV increments
    - Satisfy underwriter guidelines
    - General tendency towards even LTVs

Appraisal standards

- Is it permissible for appraisers to target contract purchase prices?

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  - Clearly, the answer is no:
    - "an appraiser must not accept an assignment... that is contingent on... reporting a predetermined result [or] a direction in assignment results that favors the cause of the client." (Uniform Standards of Appraisal Practice 2014)
    - "an appraiser must develop an opinion of market value impartially and objectively." (FAQ guidance from Appraisal Standards Board)

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    - Surprisingly, the answer is somewhat ambiguous
        - Uniform Standards require appraisers to "analyze" contract prices
          Appraisal standards and FAQ

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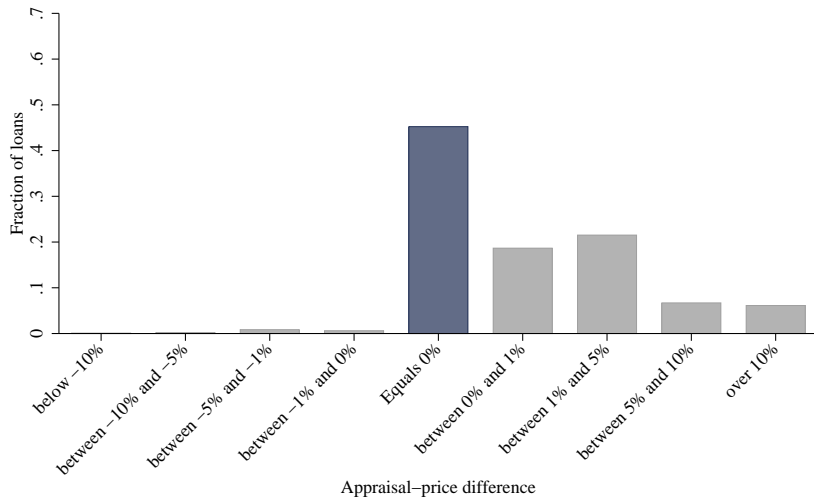
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▶ Independently, appraisal targeting is inconsistent with how appraisals are described to investors in RMBS prospectuses
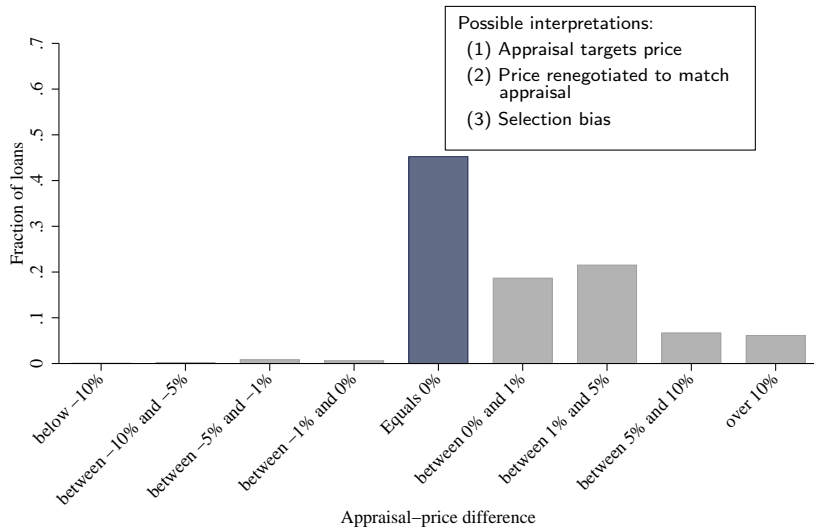 Excerpts from RMBS propectuses

Purchase loan appraisal targeting
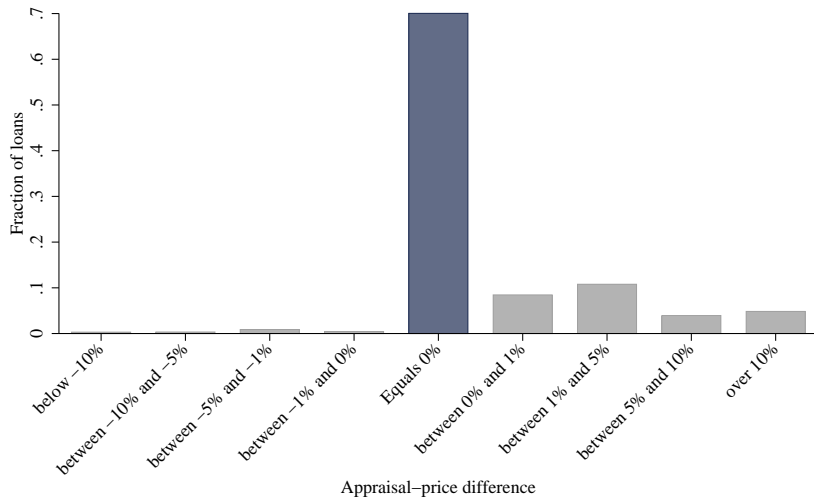
New Century funded loans

Appraisal–price difference

Purchase loan appraisal targeting

New Century funded loans

Possible interpretations:
(1) Appraisal targets price
(2) Price renegotiated to match appraisal
(3) Selection bias
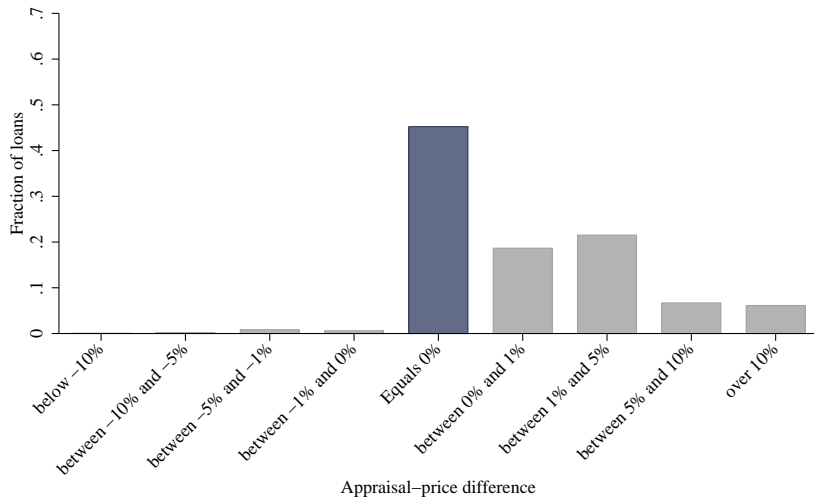
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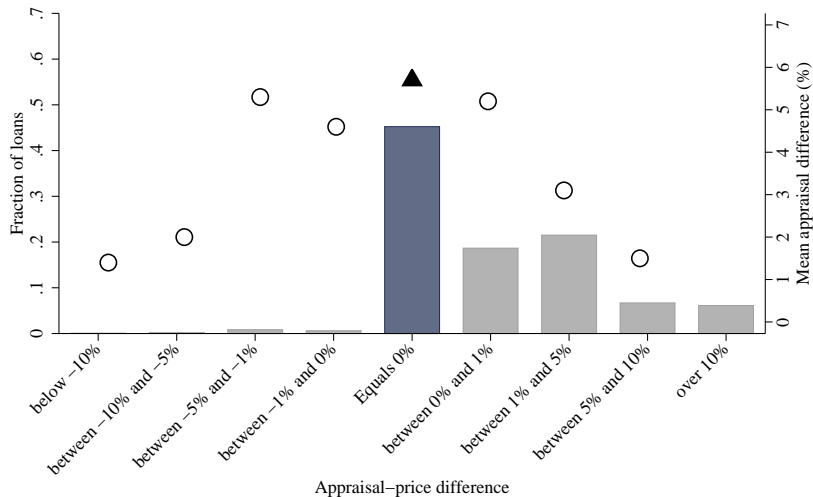
New Century **unfunded loan applications**

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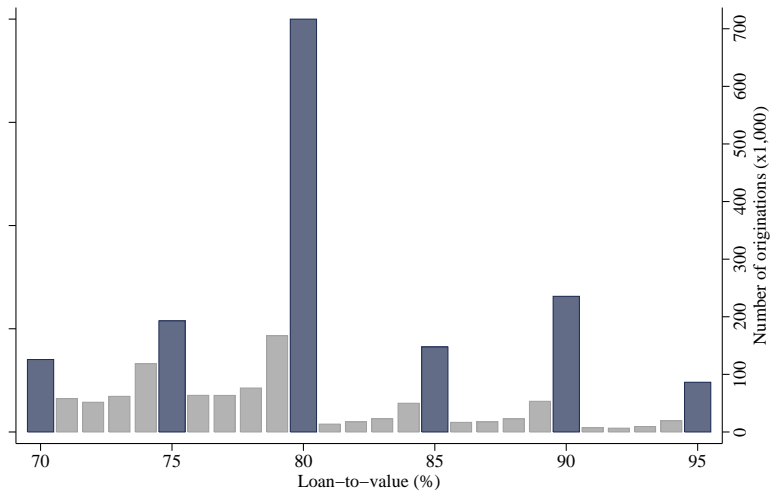   - Higher appraisal has no benefit

- Refinance loans
  - Target even LTV increments
    - Satisfy underwriter guidelines
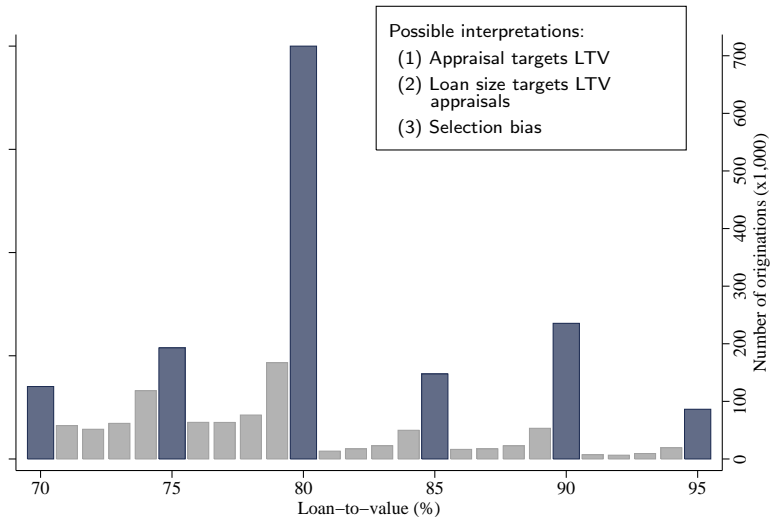   - General tendency towards even LTVs

Refinance loan appraisal targeting

All refinance loans

Refinance loan appraisal targeting
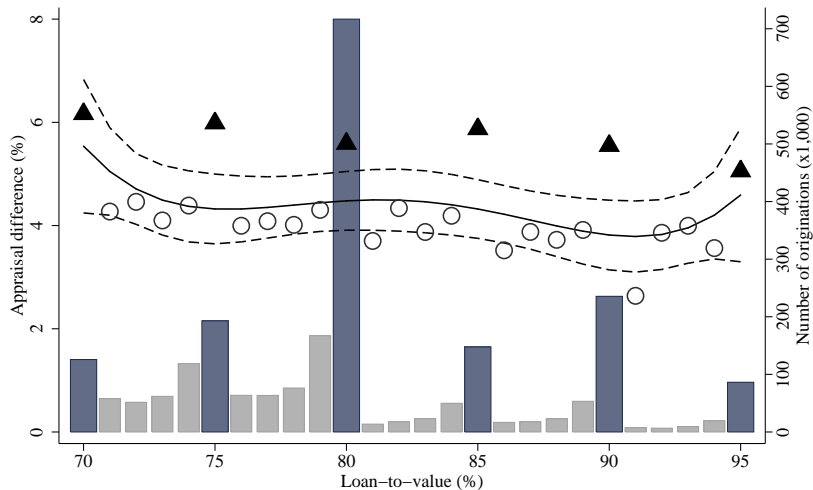
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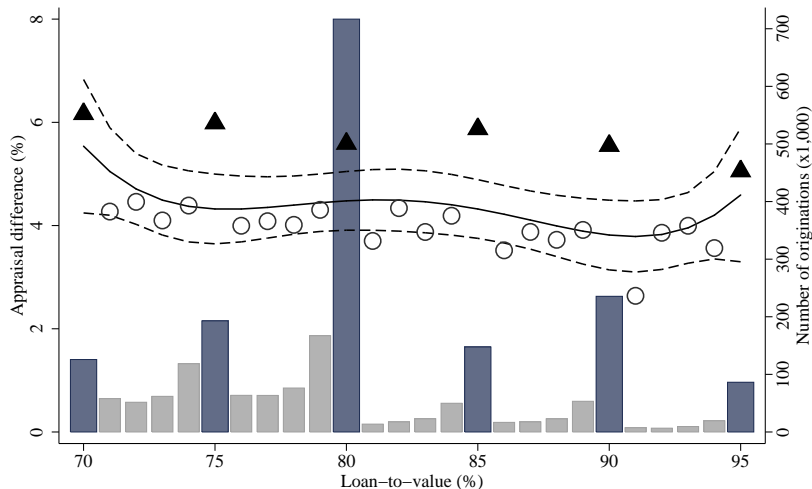
▶ Even stronger results for cash-out refinance loans Cash-out loan regressions

Refinance loan appraisal targeting

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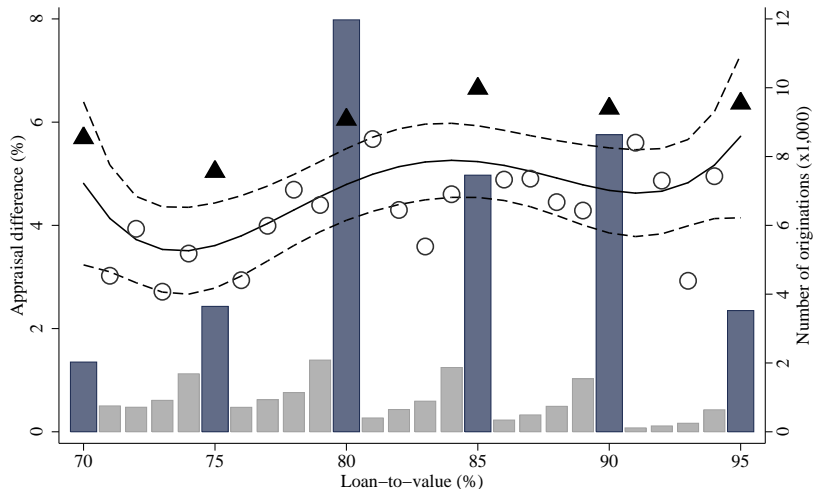
Refinance loan appraisal targeting

New Century **unfunded refinance loan applications**
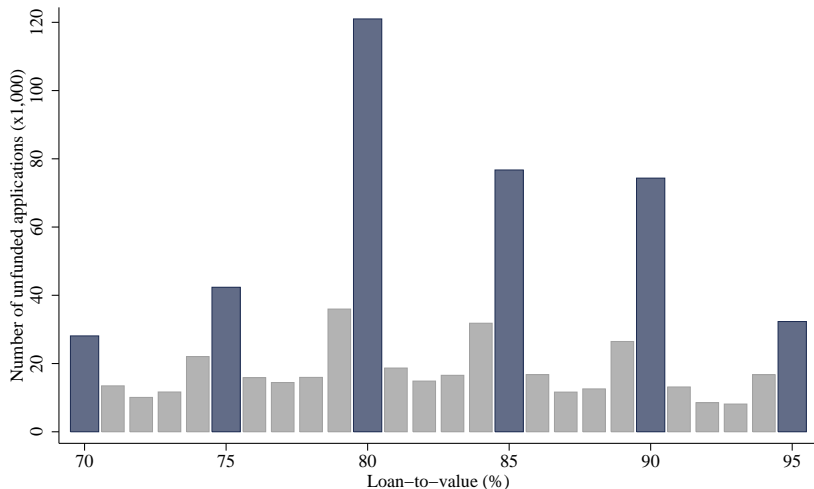
Appraisal targeting summary

- Appraisal targeting is common for both purchase and refinance loans

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- Additional evidence inconsistent with selection bias:
  - Appraisal bias is larger for refinance loans
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- Appraisal difference and unfunded loan application analyses are inconsistent with selection bias, optimism, or purchase price and loan amount adjustments

- Additional evidence inconsistent with selection bias:
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- Overall, the evidence indicates that almost half of appraisals target a pre-specified valuation

Did appraisal bias hurt investors?

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  - If LTV ratios were based on AVM valuations they would be higher on average

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- Does appraisal bias affect prices?
  - Interest rates, yield spreads, subordination

Reported LTVs vs. AVM-based LTVs

Panel A: Loan-to-value ratios				
	Refinance		Purchase	
	N=3,662,156		N=2,272,782	
	Reported LTV	AVM-based LTV	Reported LTV	AVM-based LTV
Mean (%)	72.9	79.3	80.8	85.6
Median (%)	75.9	78.0	80.0	81.0
% of loans with LTV over:				
80%	21.2	45.4	22.5	53.9
90%	4.9	26.0	11.5	27.8
100%	0.06	14.2	0.2	14.5

Panel B: Combined loan-to-value ratios				
	Refinance		Purchase	
	N=3,662,156		N=2,272,782	
	Reported CLTV	AVM-based CLTV	Reported CLTV	AVM-based CLTV
Mean (%)	74.2	80.8	86.4	91.5
Median (%)	77.2	79.0	88.6	88.4
% of loans with CLTV over:				
80%	28.6	47.9	52.9	67.6
90%	8.5	29.6	36.4	46.0
100%	0.08	16.8	0.3	25.1

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Delinquency rates and LTVs

Refinance loans
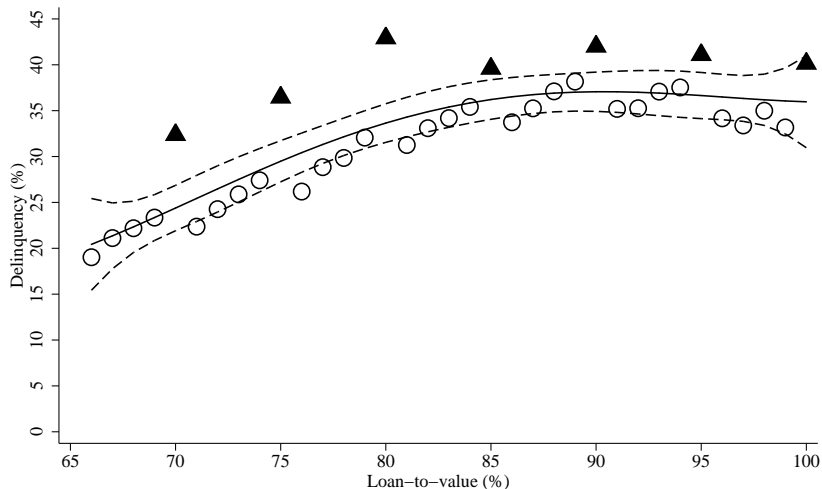
Interest rates and LTVs

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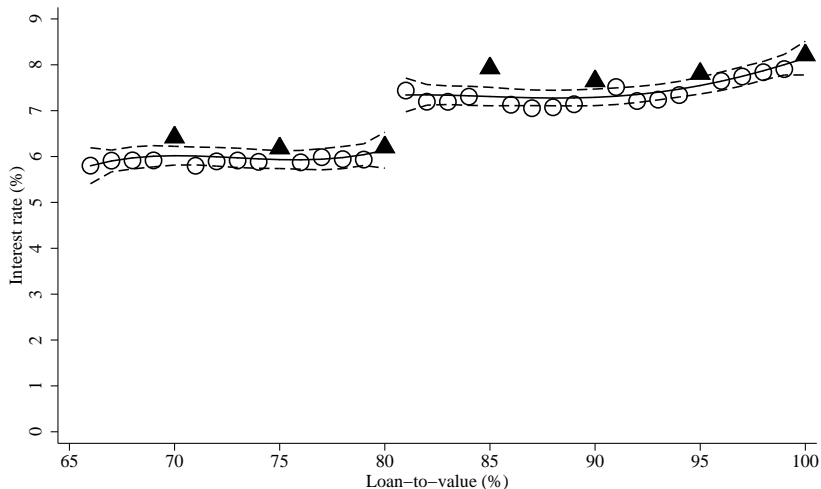
Delinquency and loan interest rates

Refinance loans

	Delinquent		
	(1)	(2)	(3)
Mean (%)	30.2	30.2	30.2
AD	5.450***		3.499***
	(0.332)		(0.355)
Even LTV		9.385***	4.191***
		(0.250)	(0.161)
AD×Even LTV			4.080***
			(0.515)
Controls	yes	yes	yes
CBSA×Quarter FE	yes	yes	yes
N	3,662,156	3,662,156	3,662,156
R^2	0.27	0.26	0.27

Delinquency and loan interest rates

Refinance loans

	Delinquent			Interest rate		
	(1)	(2)	(3)	(4)	(5)	(6)
Mean (%)	30.2	30.2	30.2	6.4	6.4	6.4
AD	5.450***		3.499***	0.016		-0.024*
	(0.332)		(0.355)	(0.012)		(0.014)
Even LTV		9.385***	4.191***		0.186***	0.183***
		(0.250)	(0.161)		(0.008)	(0.008)
AD×Even LTV			4.080***			0.068***
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CBSA×Quarter FE	yes	yes	yes	yes	yes	yes
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▶ Similar results for purchase loans Purchase loan regressions

RMBS losses and pricing

	Losses			
	(1)	(2)		
Mean (%)	20.4	20.5		
Average AD	36.978***			
	(10.367)			
Percentage Even LTV		15.324***		
		(3.027)		
Controls	yes	yes		
Underwriter FE	yes	yes		
Vintage FE	yes	yes		
N	694	517		
R^2	0.81	0.83		

RMBS losses and pricing

	Losses		Yield spread		Subordination	
	(1)	(2)	(3)	(4)	(5)	(6)
Mean (%)	20.4	20.5	0.29	0.30	12.0	12.4
Average AD	36.978***		0.054		1.769	
	(10.367)		(0.139)		(4.764)	
Percentage Even LTV		15.324***		0.039		2.515*
		(3.027)		(0.048)		(1.310)
Controls	yes	yes	yes	yes	yes	yes
Underwriter FE	yes	yes	yes	yes	yes	yes
Vintage FE	yes	yes	yes	yes	yes	yes
N	694	517	694	517	694	517
R^2	0.81	0.83	0.56	0.53	0.84	0.86

Why were reported appraisals biased upward?

- ▶ Explanations:
  1. Intentional inflation
  2. Selection bias (Demiroglu and James 2016)
     - Appraisals are somewhat noisy, and loan applications with low appraisals tend not to be completed

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- ▶ Differentiate between explanations:
  - ■ Appraisal targeting evidence
  - ■ Selection bias simulation

Bias-free simulations

- Follow Demiroglu and James (2016) to estimate a counterfactual for what the distribution of appraisal differences would be without appraisal bias

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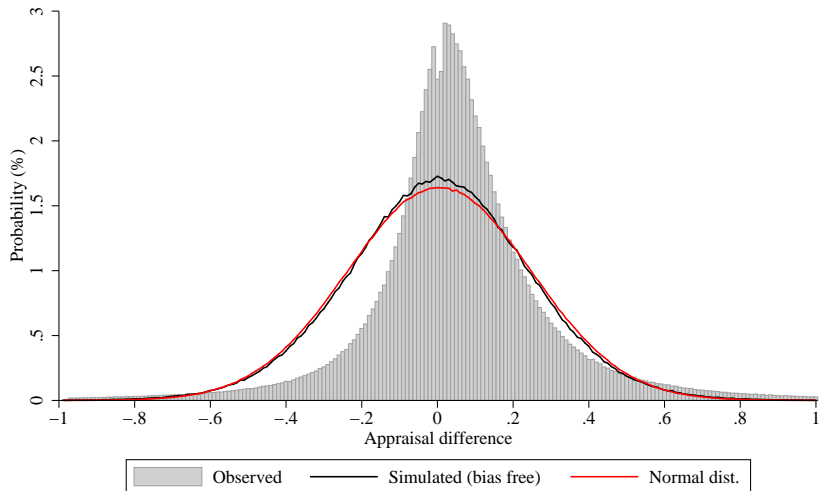
▶ Simulate

$$Appraisal_i = V_i(1 + \epsilon_i)$$
$$AVM_i = V_i(1 + \eta_i)$$

■ V_i is the true home value, which can be normalized to one
■ ϵ_i and η_i are random error terms that are jointly normally distributed with:
  • Zero mean
  • Equal standard deviations calibrated so that the simulated standard deviation of AD equals the empirical standard deviation of AD
  • Error correlations of 0.25 and 0.5 respectively for refinance and purchase loans

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▶ Follow Demiroglu and James (2016) to estimate a counterfactual for what the distribution of appraisal differences would be without appraisal bias

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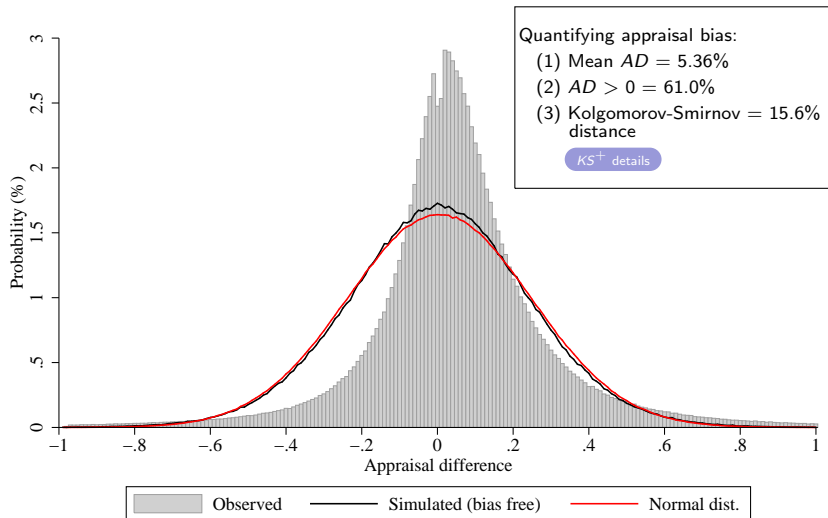▶ Simulate refinance loans and purchase loans separately

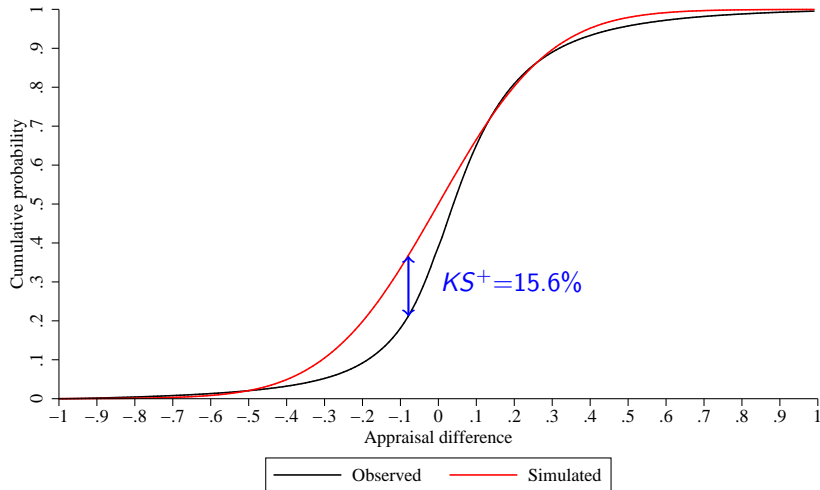# Probability distribution of appraisal differences

Refinance loans

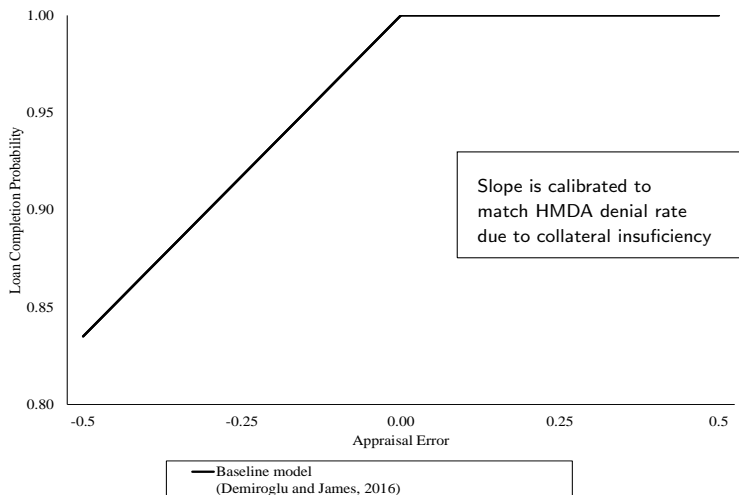# Probability distribution of appraisal differences

Refinance loans

Quantifying appraisal bias:
(1) Mean $AD = 5.36\%$
(2) $AD > 0 = 61.0\%$
(3) Kolgomorov-Smirnov = 15.6% distance

KS^+ details

# Cumulative distribution of appraisal differences

Refinance loans

KS$^+$=15.6%

Selection bias

▶ Add selection bias by modeling loan completion probability as a function of appraisal error

Slope is calibrated to match HMDA denial rate due to collateral insuficiency

Baseline model
(Demiroglu and James, 2016)

Selection bias

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Slope is calibrated to match HMDA denial rate due to collateral insuficiency
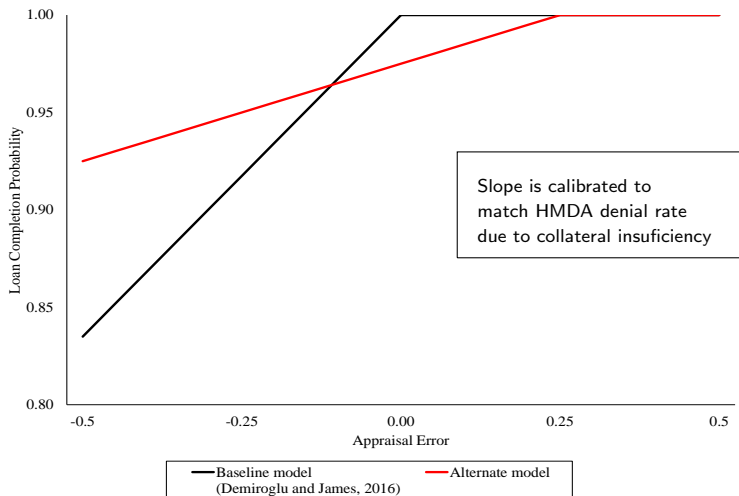
Simulation results

Refinance loans

	Collateral denial rates	Appraisal bias measures		
		Mean AD	Excess positive AD	KS$^+$
Data	2.5	5.36	10.98	15.59
Bias-free simulation	0	-0.04	-0.05	0

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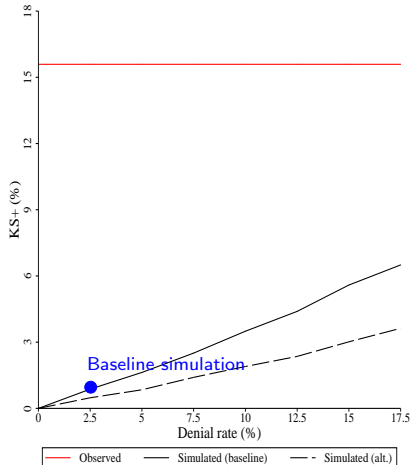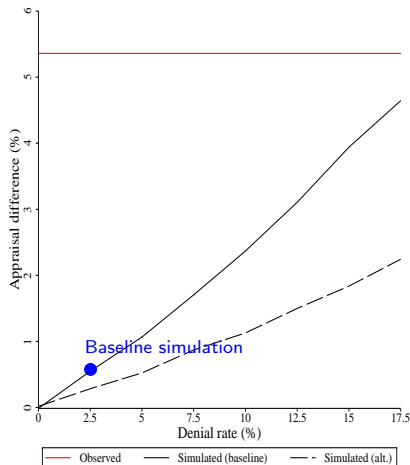▶ Similar results for purchase loans Purchase simulations

Sensitivity with respect to denial rates
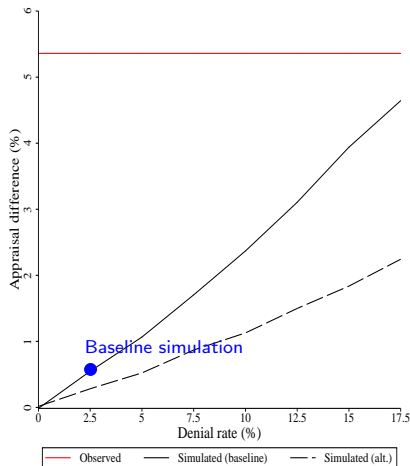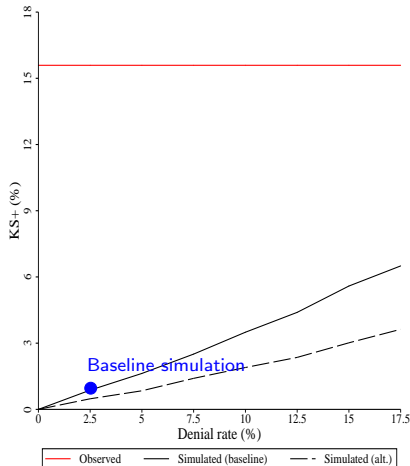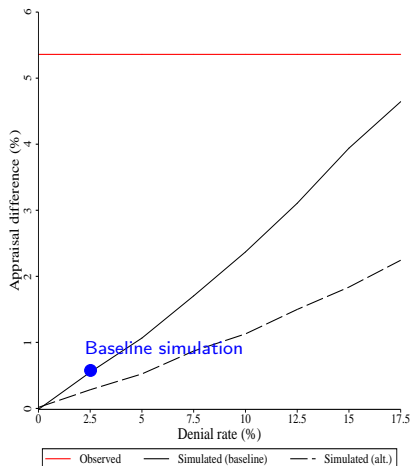
Refinance loans

Sensitivity with respect to denial rates

Refinance loans

# Sensitivity with respect to denial rates

Refinance loans

▶ Similar results for excess positive AD `Excess positive AD sensitivity`

Who facilitated collateral misreporting?

- ▶ Does appraisal bias vary across loan officers, mortgage brokers, and appraisers?

- ▶ Does past appraisal bias predict subsequent appraisal bias?

Appraisal difference distribution of loan officers, mortgage brokers, and appraisers
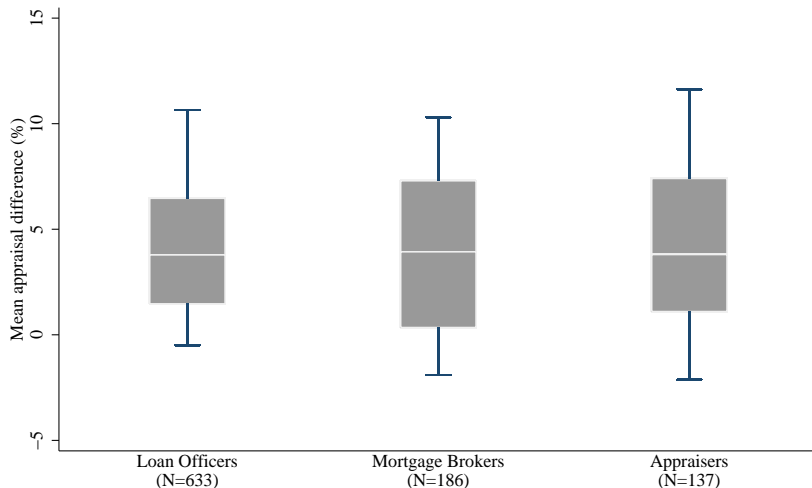
Appraisal bias persistence

	(1)	(2)	(3)
Mean AD	4.87	4.76	5.17
Loan Officer Lagged AD	0.39**		
	(0.16)		
Broker Lagged AD		1.44***	
		(0.32)	
Appraiser Lagged AD			2.42**
			(1.16)
Control Variables	Yes	Yes	Yes
CBSA×Quarter FE	Yes	Yes	Yes
N	35,737	6,728	1,507
R^2	0.117	0.159	0.116

Conclusion

- ▶ Appraisal bias
  - ■ Is large and widespread
    - • Appraisals are biased upward by 5% on average, half of purchase loans are biased upward, and appraisal bias is pervasive across different loan characteristics

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  - Hurts investors
    - Reported LTVs are 5% lower than true LTVs on average
    - If LTV ratios were based on AVM valuations, 14% of LTV ratios and 17-25% of CLTV ratios would be over 100%
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  ■ Comes from intentional appraisal targeting as opposed to selection bias

  ■ In part stems from decisions of individual loan officers, mortgage brokers, and appraisers
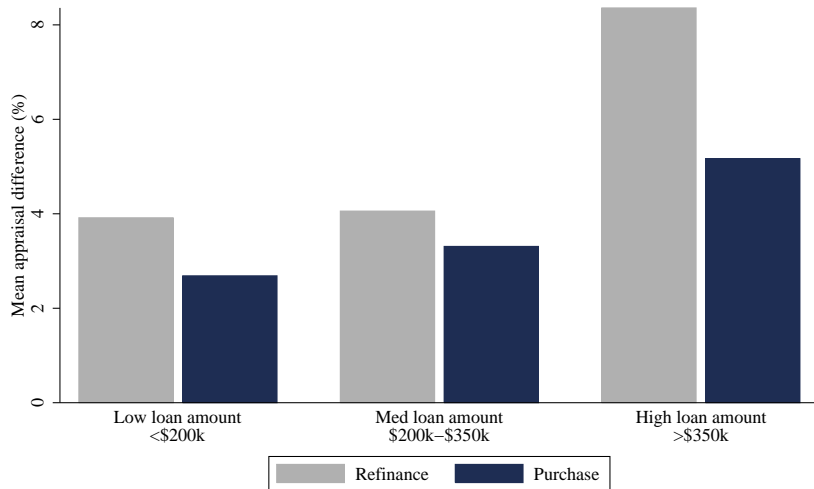
APPENDIX

Time-series of appraisal bias
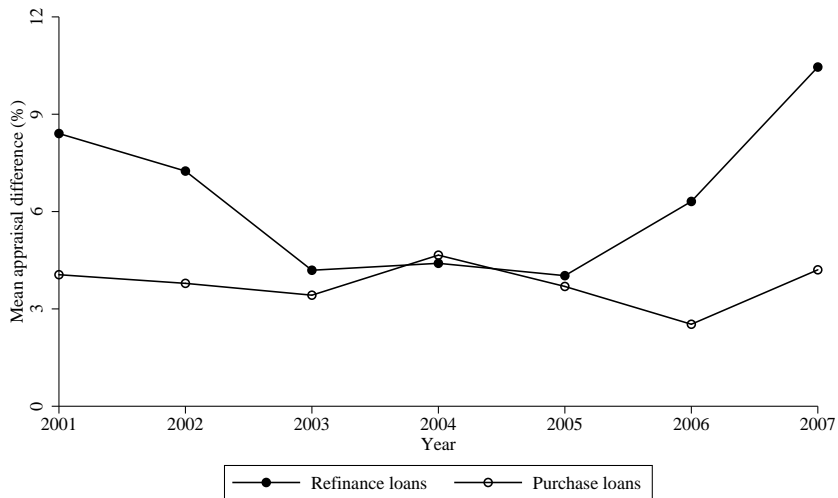
Appraisal bias and loan amount

Appraisal Standards

- From the FAQ Guidance to Uniform Standards of Appraisal Practice:
    - "A contract sale price, while a significant piece of market data, must not become a target in an appraisal assignment"
    - "if an appraiser consistently concludes that the contract sale price of any property they appraise equals market value, particularly when a competent analysis of credible market data indicates otherwise, the appraiser's impartiality, objectivity and independence appear to have been compromised. The ETHICS RULE clearly prohibits such a practice"

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Excerpts from RMBS prospectuses

NEW CENTURY HOME EQUITY LOAN TRUST 2004-3
Prospectus Supplement dated September 27, 2004

- ▶ "Mortgaged properties that are to secure mortgage loans generally are appraised by qualified independent appraisers. These appraisers inspect and appraise the subject property and verify that the property is in acceptable condition. Following each appraisal, the appraiser prepares a report which includes a market value analysis based on recent sales of comparable homes in the area and, when deemed appropriate, replacement cost analysis based on the current cost of constructing a similar home. All appraisals are required to conform to the Uniform Standards of Professional Appraisal Practice adopted by the Appraisal Standards Board of the Appraisal Foundation and are generally on forms acceptable to Fannie Mae and Freddie Mac."

J.P. MORGAN MORTGAGE ACQUISITION TRUST 2006-WMC4
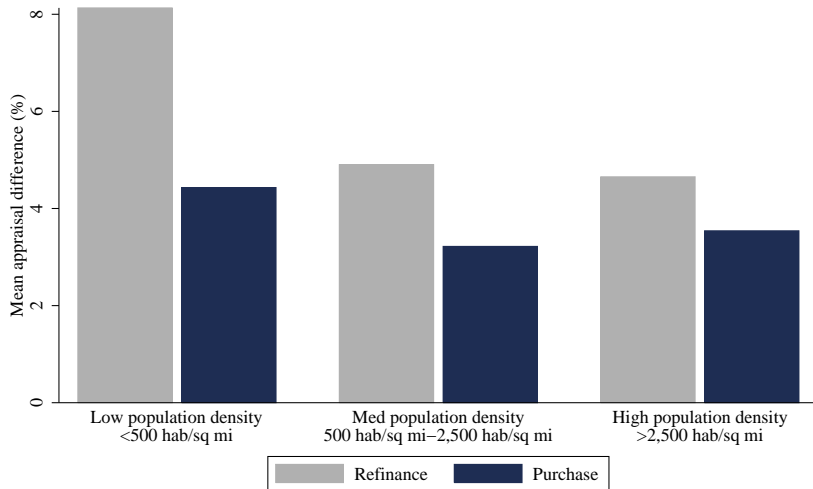Prospectus Supplement dated December 15, 2006

- ▶ "The Underwriting Guidelines are applied in accordance with a procedure which complies with applicable federal and state laws and regulations and requires, among other things, (1) an appraisal of the mortgaged property which conforms to Uniform Standards of Professional Appraisal Practice and (2) an audit of such appraisal by a WMC-approved appraiser or by WMC's in-house collateral auditors (who may be licensed appraisers) and such audit may in certain circumstances consist of a second appraisal, a field review, a desk review or an automated valuation model. Each appraisal includes a market data analysis based on recent sales of comparable homes in the area."

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Appraisal bias and household income
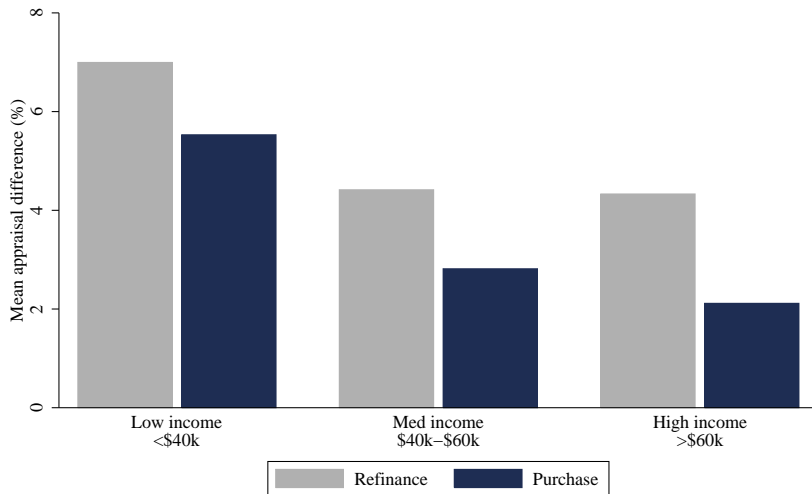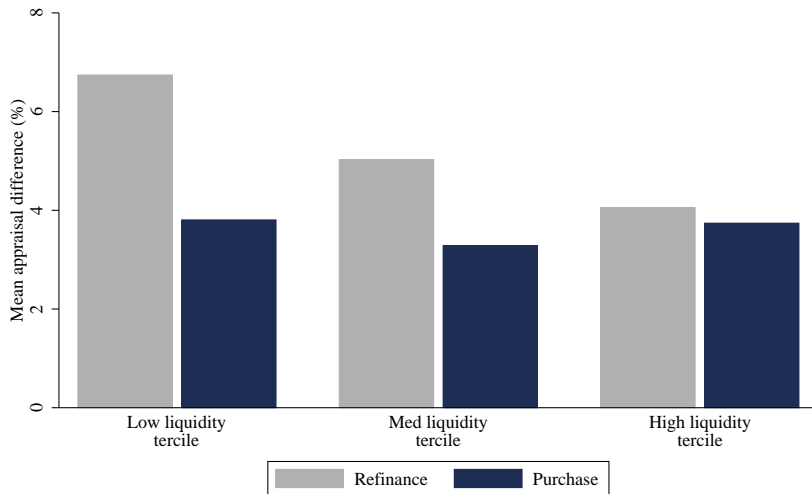
Appraisal bias and population density

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Appraisal bias and home market liquidity

Figure: Bar chart of Mean appraisal difference (%) by liquidity tercile (Low, Med, High) for Refinance and Purchase.

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Geographic distribution of appraisal bias

Refinance loans
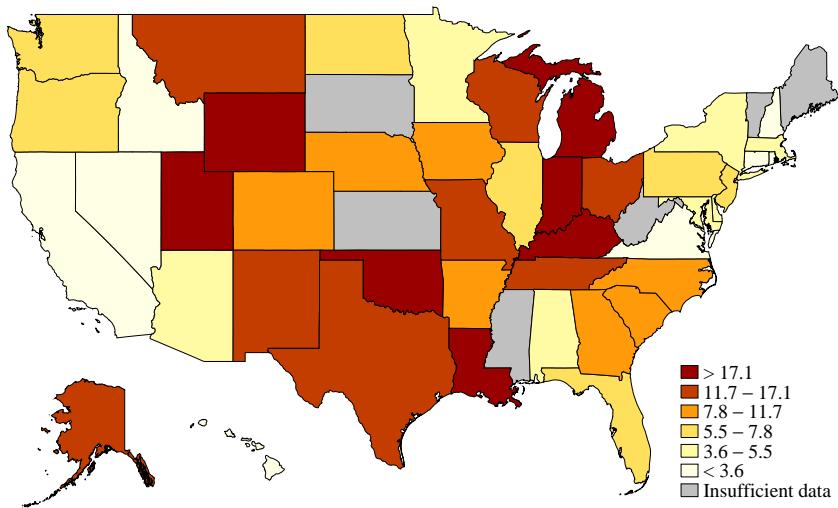
Legend:
- > 17.1
- 11.7 − 17.1
- 7.8 − 11.7
- 5.5 − 7.8
- 3.6 − 5.5
- < 3.6
- Insufficient data

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Geographic distribution of appraisal differences

Purchase loans

Legend:
- > 8.3
- 5.7 − 8.3
- 4.1 − 5.7
- 2.7 − 4.1
- 1.5 − 2.7
- < 1.5
- Insufficient data

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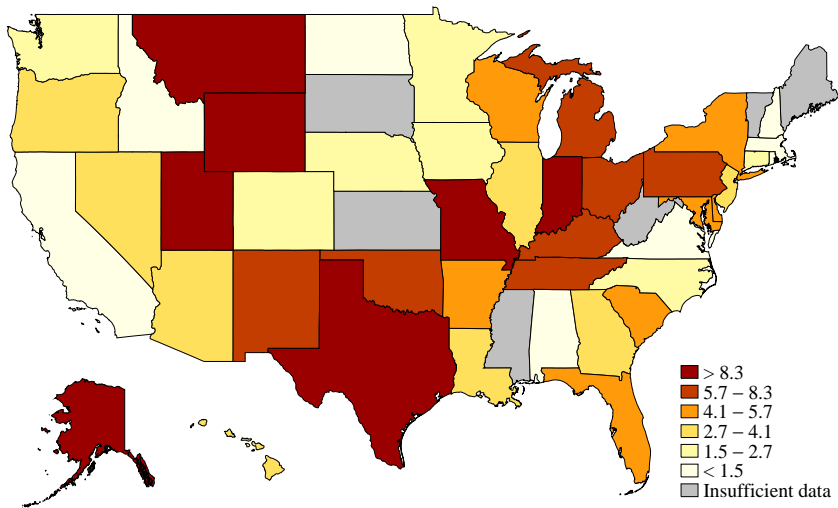
Appraisal difference and refinance targeting

Cash-out refinance loans

	Appraisal Difference			Even LTV
	(1)	(2)	(3)	(4)
Mean (%)	5.4	5.4	5.4	45.2
Even LTV	1.518***		1.435***	
	(0.103)		(0.098)	
Cashout		1.319***	1.208***	7.689***
		(0.126)	(0.124)	(0.430)
Controls	yes	yes	yes	yes
CBSA×Quarter FE	yes	yes	yes	yes
N	3,662,156	3,662,156	3,662,156	3,662,156
R^2	0.11	0.11	0.11	0.25

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Delinquency and loan interest rates

Purchase loans

	Delinquent			Interest rate		
	(1)	(2)	(3)	(4)	(5)	(6)
Mean (%)	48.9	48.9	48.9	7.8	7.8	7.8
AD	7.569***		6.224***	-0.051**		-0.060***
	(0.975)		(1.055)	(0.023)		(0.023)
A=Price		15.341***	13.980***		0.219***	0.220***
		(0.743)	(0.782)		(0.015)	(0.017)
AD×A=Price			8.109***			0.012
			(3.084)			(0.053)
Controls	yes	yes	yes	yes	yes	yes
CBSA×Quarter FE	yes	yes	yes	yes	yes	yes
N	70,325	70,325	70,325	70,325	70,325	70,325
R^2	0.28	0.27	0.29	0.60	0.60	0.60

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Positive Kolmogorov-Smirnov distance

▶ How different is the empirical appraisal difference distribution from the bias-free benchmark?

▶ We employ a modified version of the Kolmogorov-Smirnov statistic:

$$KS^+ \equiv \sup_x (F_{AD}(x) - F_{sim}(x)), \qquad (2)$$

- $F_{AD}(x) - F_{sim}(x)$ is the minimum fraction of loans that must be biased to explain differences in how many loans have AD above the threshold x
- KS^+ is the maximum of these differences
  - Lower bound on the fraction of loans that must be biased

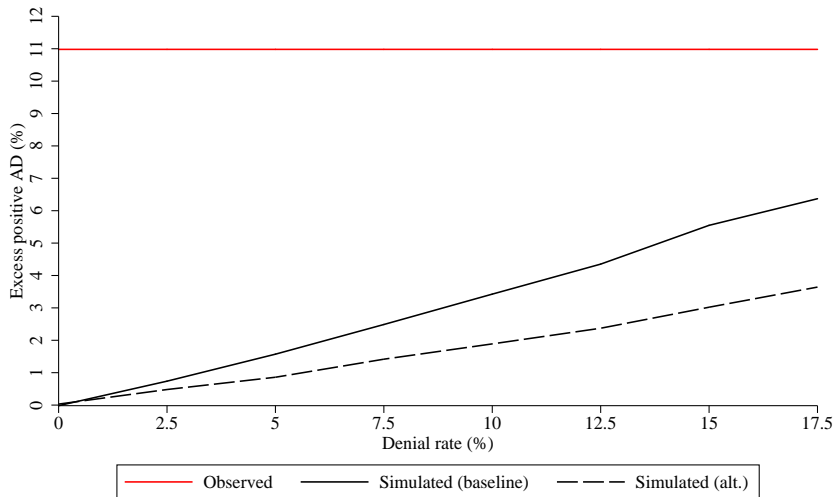Back to slides

Simulation results

Purchase loans

	Collateral denial rates	Appraisal bias measures		
		Mean AD	Excess positive AD	KS$^+$
Data	1.7	3.62	7.56	15.67
Bias-free simulation	0	0.01	0.08	0
Selection bias simulation	1.7	0.27	0.47	0.74

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Sensitivity with respect to denial rates

Refinance loans

AVM-based LTV distribution

Refinance loans