Discussion of

Collateral Misreporting in the RMBS Market

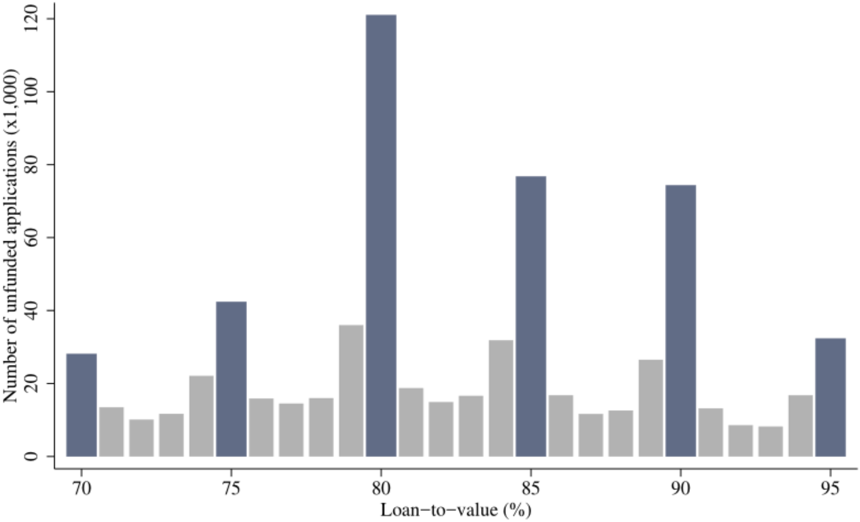
by Samuel Kruger and Gonzalo Maturana

Vadim Elenev

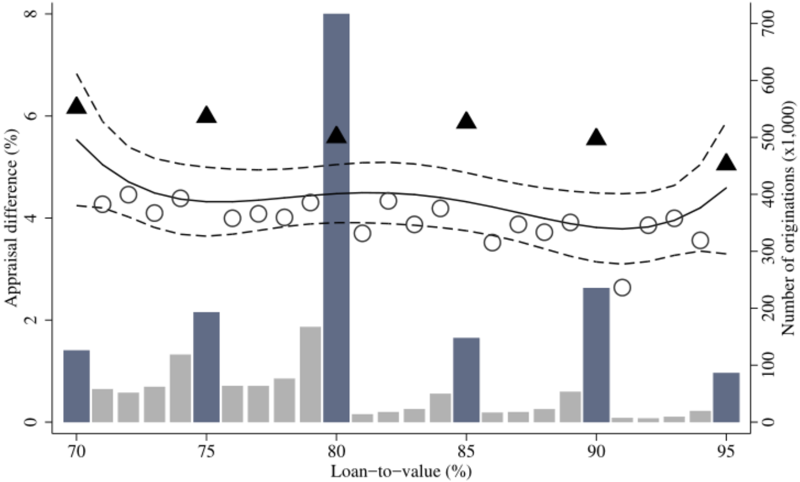
Johns Hopkins Carey

Midwest Finance Association Conference — March 2018

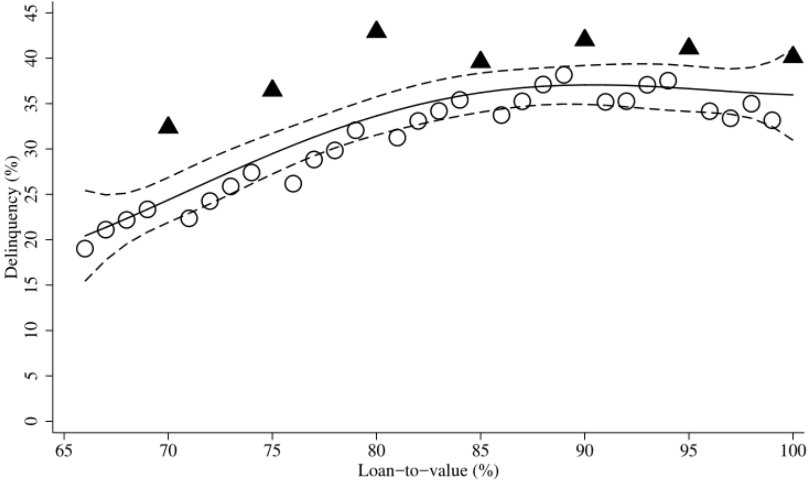
LTVs of **even unfunded** refinance applications cluster suspiciously...



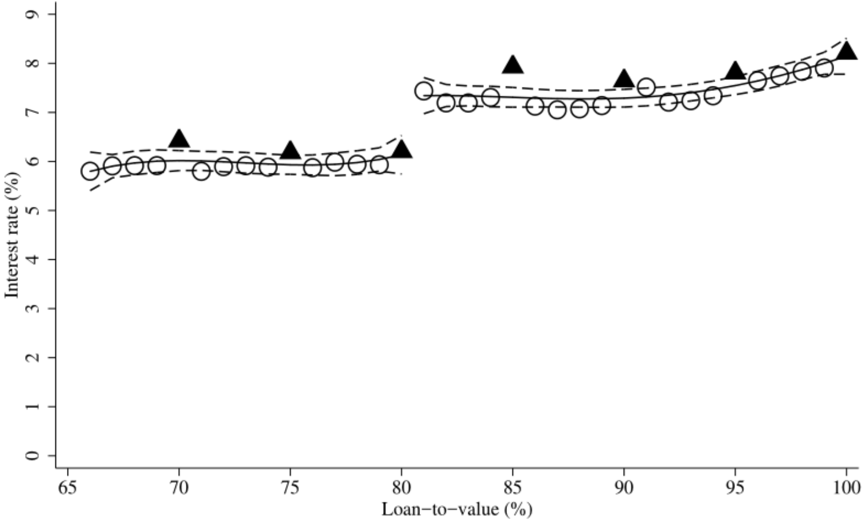
...because appraisers overstate value to hit round numbers



These loans predictably end up riskier...



...and originators understand that...



But RMBS investors don't.

	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 Round LTV		15.324***		0.039		2.515*
		(3.027)		(0.048)		(1.310)
Average FICO	-0.060***	-0.049***	-0.0004***	-0.0005***	-0.082***	-0.094***
	(0.008)	(0.010)	(0.0001)	(0.0001)	(0.004)	(0.005)
Other controls	yes	yes	yes	yes	yes	yes
Underwriter FE	yes	yes	yes	yes	yes	yes
Deal year 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

Comments

- I really like this paper!
  - Are appraisals intentionally biased? Almost certainly **yes** (my prior was **yes**)

Comments

- I really like this paper!
  - Are appraisals intentionally biased? Almost certainly **yes** (my prior was **yes**)
  - Do end investors understand that? Seemingly **no** (my prior was **yes**)

Comments

- I really like this paper!
  - Are appraisals intentionally biased? Almost certainly **yes** (my prior was **yes**)
  - Do end investors understand that? Seemingly **no** (my prior was **yes**)
- Three comments
  - Quantitative Magnitude
  - Contracting environment of appraising

Quantitative Magnitude: This is a big deal!

- Partial Equilibrium back-of-the-envelope math:
    - Mean loan: $290K; Mean (biased) LTV: 75.9%; Mean appraisal difference: 4.69%
    - $\implies$ Corrected LTV: 79.5%
    - If investors wanted LTVs of 75.9%, misreporting netted borrowers extra $13K per loan.
    - This paper is about non-agency loans, but similar magnitudes have been found for conforming loans – billions of dollars of "extra" lending!

Quantitative Magnitude: This is a big deal!

- Partial Equilibrium back-of-the-envelope math:
  - Mean loan: \$290K; Mean (biased) LTV: 75.9%; Mean appraisal difference: 4.69%
  - $\implies$ Corrected LTV: 79.5%
  - If investors wanted LTVs of 75.9%, misreporting netted borrowers extra \$13K per loan.
  - This paper is about non-agency loans, but similar magnitudes have been found for conforming loans – billions of dollars of "extra" lending!
  - RMBS losses would have been 18.7% (instead of 20.4%) without appraisal bias

Quantitative Magnitude: This is a big deal!

- Partial Equilibrium back-of-the-envelope math:
  - Mean loan: $290K; Mean (biased) LTV: 75.9%; Mean appraisal difference: 4.69%
  - $\implies$ Corrected LTV: 79.5%
  - If investors wanted LTVs of 75.9%, misreporting netted borrowers extra $13K per loan.
  - This paper is about non-agency loans, but similar magnitudes have been found for conforming loans – billions of dollars of "extra" lending!
  - RMBS losses would have been 18.7% (instead of 20.4%) without appraisal bias
- General Equilibrium Amplification
  - Effective relaxation of collateral constraint by 3.6pp
  - Increases aggregate housing demand, leading to both higher prices and more construction
  - Appraisal bias is on top of already inflated house prices!

Quantitative Magnitude: This is a big deal!

- Partial Equilibrium back-of-the-envelope math:
  - Mean loan: \$290K; Mean (biased) LTV: 75.9%; Mean appraisal difference: 4.69%
  - $\Longrightarrow$ Corrected LTV: 79.5%
  - If investors wanted LTVs of 75.9%, misreporting netted borrowers extra \$13K per loan.
  - This paper is about non-agency loans, but similar magnitudes have been found for conforming loans – billions of dollars of "extra" lending!
  - RMBS losses would have been 18.7% (instead of 20.4%) without appraisal bias
- General Equilibrium Amplification
  - Effective relaxation of collateral constraint by 3.6pp
  - Increases aggregate housing demand, leading to both higher prices and more construction
  - Appraisal bias is on top of already inflated house prices!
  - Lots of negative consequences: misallocation of resources, excess volatility due to dynamics of appraisal bias, etc.

Contracting Environment of Appraisal: Humans vs. Machines

- Appraisers vs. AVM
  Theoretically,
  - AVM: more accurate b/c unbiased (tautologically given authors' definition of bias)
  - Appraisers: more precise b/c incorporate soft information

Contracting Environment of Appraisal: Humans vs. Machines

- Appraisers vs. AVM
  Theoretically,
  - AVM: more accurate b/c unbiased (tautologically given authors' definition of bias)
  - Appraisers: more precise b/c incorporate soft information
- But are human appraisers more precise?

Contracting Environment of Appraisal: Humans vs. Machines

- Appraisers vs. AVM
  Theoretically,
  - AVM: more accurate b/c unbiased (tautologically given authors' definition of bias)
  - Appraisers: more precise b/c incorporate soft information
- But are human appraisers more precise?
  - Probably not the ones targeting round LTV ratios! But what about others?

Contracting Environment of Appraisal: Humans vs. Machines

- Appraisers vs. AVM
  Theoretically,
  - AVM: more accurate b/c unbiased (tautologically given authors' definition of bias)
  - Appraisers: more precise b/c incorporate soft information
- But are human appraisers more precise?
  - Probably not the ones targeting round LTV ratios! But what about others?
  - Ideal setting: $i = 1, \ldots, n$ houses with identical observables both appraised at time 0, sold at time t

Contracting Environment of Appraisal: Humans vs. Machines

- Appraisers vs. AVM
  Theoretically,
  - AVM: more accurate b/c unbiased (tautologically given authors' definition of bias)
  - Appraisers: more precise b/c incorporate soft information
- But are human appraisers more precise?
  - Probably not the ones targeting round LTV ratios! But what about others?
  - Ideal setting: $i = 1, \ldots, n$ houses with identical observables both appraised at time 0, sold at time t
  - Is $\text{Var}_i[\log P_i^t - \log \text{Appraisal}_i^0] < \text{Var}_i[\log P_i^t - \log \text{AVM}_i^0]$?

Contracting Environment of Appraisal: Humans vs. Machines

- Appraisers vs. AVM
  Theoretically,
  - AVM: more accurate b/c unbiased (tautologically given authors' definition of bias)
  - Appraisers: more precise b/c incorporate soft information
- But are human appraisers more precise?
  - Probably not the ones targeting round LTV ratios! But what about others?
  - Ideal setting: $i = 1, \ldots, n$ houses with identical observables both appraised at time 0, sold at time t
  - Is $\mathrm{Var}_i[\log P_i^t - \log \mathrm{Appraisal}_i^0] < \mathrm{Var}_i[\log P_i^t - \log \mathrm{AVM}_i^0]$?
  - If no, why do we need human appraisers?!

Contracting Environment of Appraisal: Humans vs. Machines

- Appraisers vs. AVM
  Theoretically,
  - AVM: more accurate b/c unbiased (tautologically given authors' definition of bias)
  - Appraisers: more precise b/c incorporate soft information
- But are human appraisers more precise?
  - Probably not the ones targeting round LTV ratios! But what about others?
  - Ideal setting: $i = 1, \ldots, n$ houses with identical observables both appraised at time 0, sold at time t
  - Is $\text{Var}_i[\log P_i^t - \log \text{Appraisal}_i^0] < \text{Var}_i[\log P_i^t - \log \text{AVM}_i^0]$?
  - If no, why do we need human appraisers?!
  - If yes, can investors (now informed about the bias by this paper!) use AVMs to correct for mean bias while still extracting soft info from appraisals?

Contracting Environment of Appraisal: What can be Salvaged?

- How hard is it for investors to determine AVM?
  - Authors just had to buy ABSNet...
  - Is there (anecdotal?) evidence that (some?) investors are aware of AVM?

Contracting Environment of Appraisal: What can be Salvaged?

- How hard is it for investors to determine AVM?
  - Authors just had to buy ABSNet...
  - Is there (anecdotal?) evidence that (some?) investors are aware of AVM?
- Why are appraisers aware of targets (i.e. contract price, requested loan amount)?
  - They don't need to know this to value the property (ok, contract price is useful, but definitely not requested loan amount in refis).
  - Originators/borrowers tell them this because they're partners in rent extraction from uninformed RMBS investors.
  - Can RMBS investors require modification to appraiser's info set or does this have to be done through regulation?

Pricing of Appraisal-Related Risk

- Toy model: Imagine a simple world where
  - Only state variable is house price appreciation HPA
  - All mortgages have the same appraisal bias AD

Pricing of Appraisal-Related Risk

- Toy model: Imagine a simple world where
  - Only state variable is house price appreciation HPA
  - All mortgages have the same appraisal bias AD
- Define
  - $X(HPA; AD)$: payoff on mortgage with bias AD in state of the world HPA
  - $q^M(AD)$: price of that mortgage today
  - $Y(HPA; AD)$: payoff on pool of mortgages with bias AD in state of the world HPA
  - $q^{RMBS}(AD)$: price of that pool today

Pricing of Appraisal-Related Risk

- Toy model: Imagine a simple world where
  - Only state variable is house price appreciation HPA
  - All mortgages have the same appraisal bias AD
- Define
  - $X(HPA; AD)$: payoff on mortgage with bias AD in state of the world HPA
  - $q^M(AD)$: price of that mortgage today
  - $Y(HPA; AD)$: payoff on pool of mortgages with bias AD in state of the world HPA
  - $q^{RMBS}(AD)$: price of that pool today
- Paper finds

	Mortgage	RMBS
Payoff	$\frac{\partial X(HPA_{\text{realized}}; AD)}{\partial AD} < 0$	$\frac{\partial Y(HPA_{\text{realized}}; AD)}{\partial AD} < 0$
Price	$\frac{\partial q^M}{\partial AD} < 0$	$\frac{\partial q^{RMBS}}{\partial AD} \approx 0$

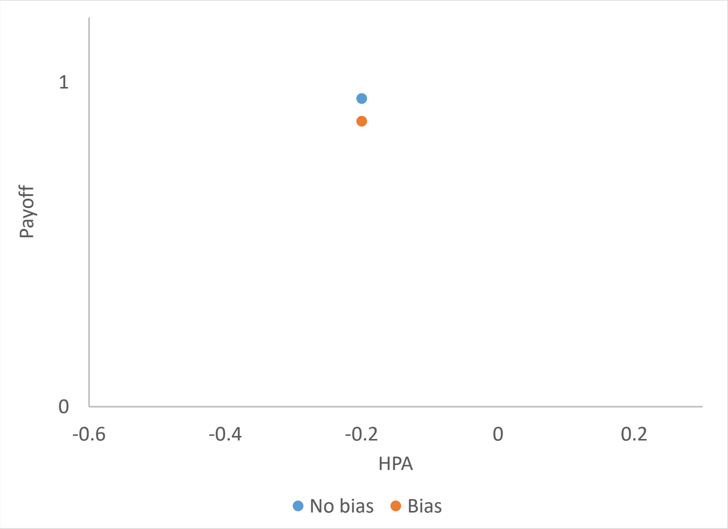
Pricing of Appraisal-Related Risk

- Toy model: Imagine a simple world where
  - Only state variable is house price appreciation HPA
  - All mortgages have the same appraisal bias AD
- Define
  - $X(HPA; AD)$: payoff on mortgage with bias AD in state of the world HPA
  - $q^M(AD)$: price of that mortgage today
  - $Y(HPA; AD)$: payoff on pool of mortgages with bias AD in state of the world HPA
  - $q^{RMBS}(AD)$: price of that pool today
- Paper finds

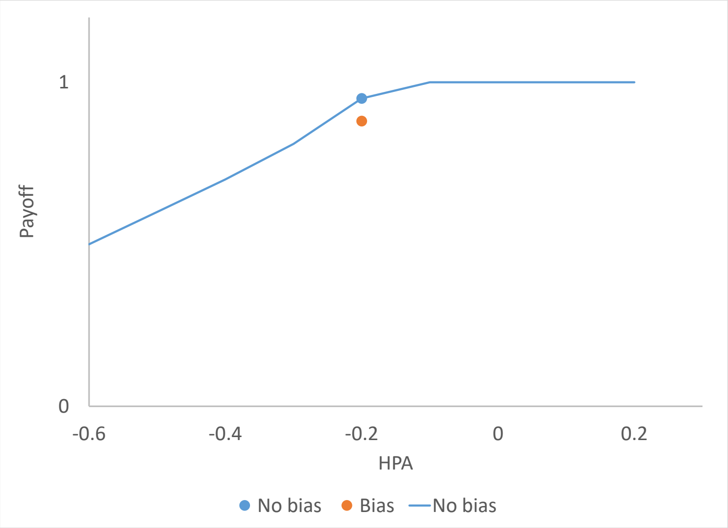
	Mortgage	RMBS
Payoff	$\frac{\partial X(HPA_{\text{realized}}; AD)}{\partial AD} < 0$	$\frac{\partial Y(HPA_{\text{realized}}; AD)}{\partial AD} < 0$
Price	$\frac{\partial q^M}{\partial AD} < 0$	$\frac{\partial q^{RMBS}}{\partial AD} \approx 0$

- Interpretation: AD isn't in RMBS investors' information set

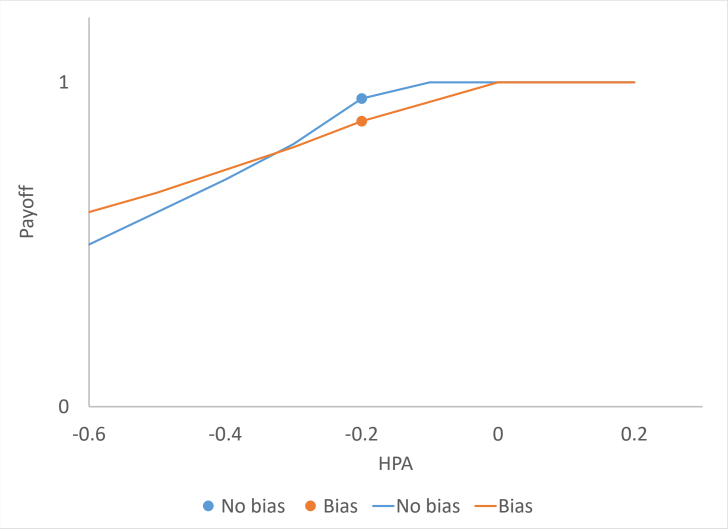
Payoff Result is only for one realization of HPA



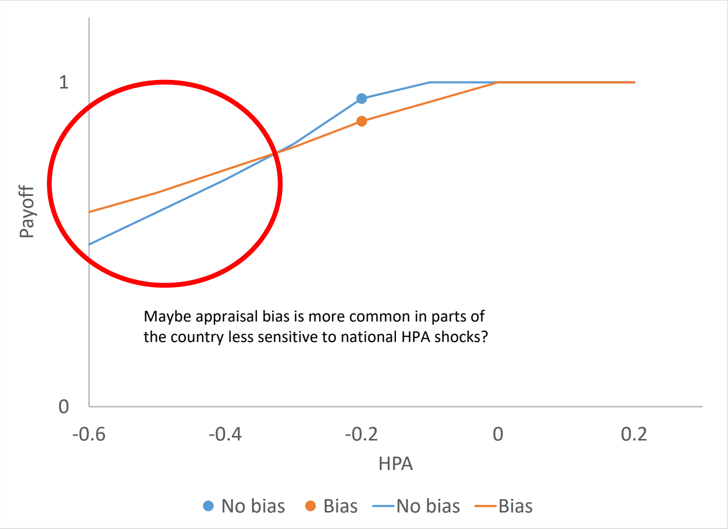
But price depends on the ex-ante distribution



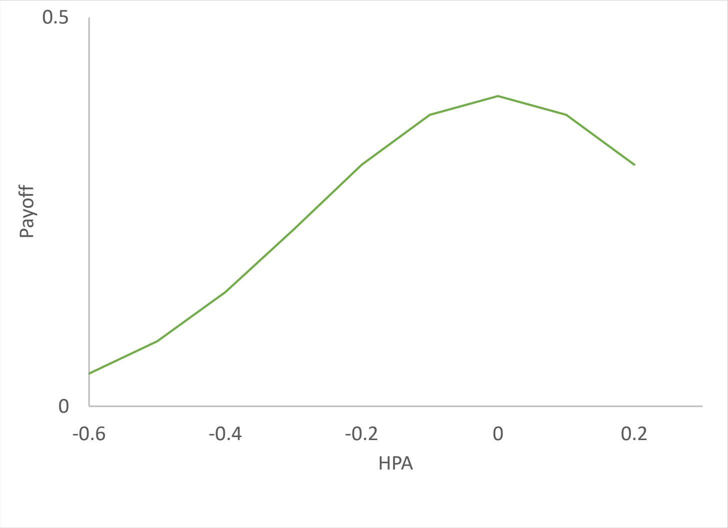
What if payoff result is reversed for other realizations?



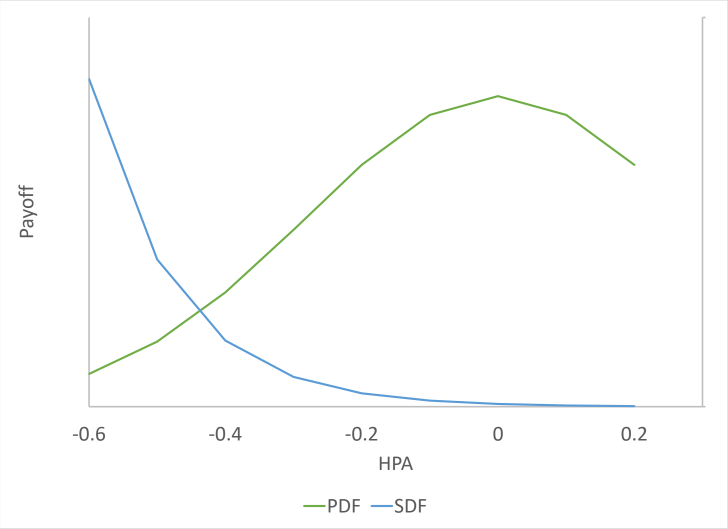
What if payoff result is reversed for other realizations?



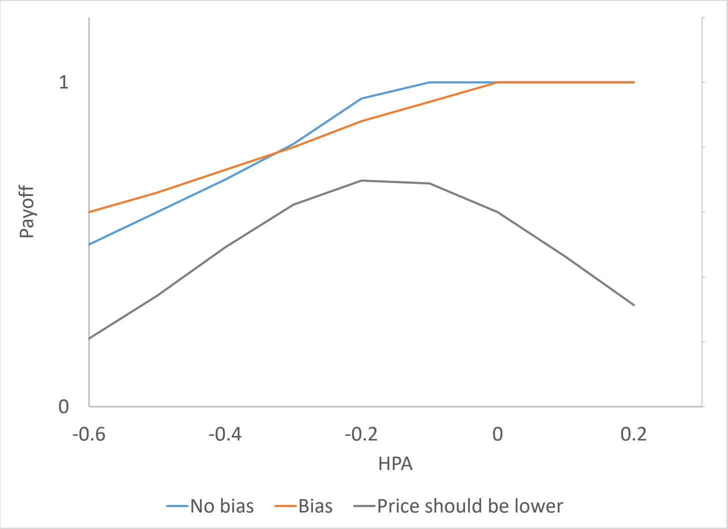
Weighing realizations: beliefs x state prices (SDF)



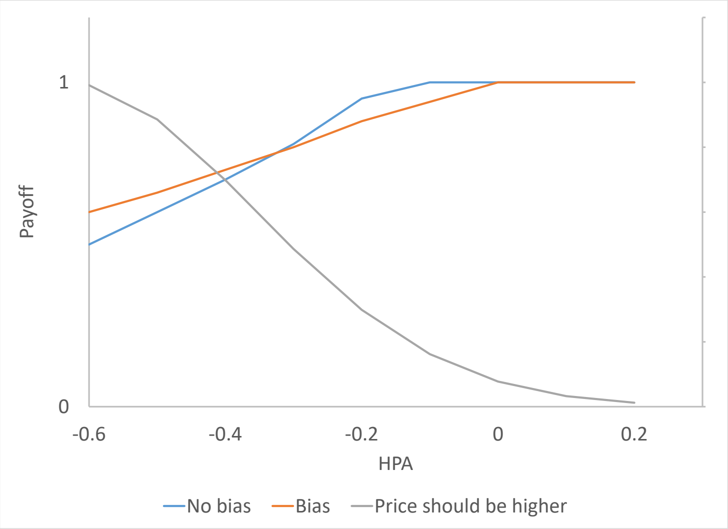
Weighing realizations: beliefs x state prices (SDF)



Mis-appraised RMBS may cost less...



...or more



Pricing of Appraisal-Related Risk

- Toy model: Imagine a simple world where
  - Only state variable is house price appreciation HPA
  - All mortgages have the same appraisal bias AD
- Define
  - $X(HPA; AD)$: payoff on mortgage with bias AD in state of the world HPA
  - $q^M(AD)$: price of that mortgage today
  - $Y(HPA; AD)$: payoff on pool of mortgages with bias AD in state of the world HPA
  - $q^{RMBS}(AD)$: price of that pool today
- Paper finds

	Mortgage	RMBS
Payoff	$\frac{\partial X(HPA_{\text{realized}}; AD)}{\partial AD} < 0$	$\frac{\partial Y(HPA_{\text{realized}}; AD)}{\partial AD} < 0$
Price	$\frac{\partial q^M}{\partial AD} < 0$	$\frac{\partial q^{RMBS}}{\partial AD} \approx 0$

- Interpretation: AD isn't in RMBS investors' information set

Formally stating the maintained hypothesis

- By no-arbitrage,

$$q^M(AD) = \mathrm{E}\left[SDF^M(HPA) \times X(HPA; AD) | \mathcal{F}^M\right]$$
$$q^{RMBS}(AD) = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD) | \mathcal{F}^{RMBS}\right]$$

Formally stating the maintained hypothesis

- By no-arbitrage,

$$q^{M}(AD) = \mathrm{E}\left[SDF^{M}(HPA) \times X(HPA; AD) | \mathcal{F}^{M}\right]$$
$$q^{RMBS}(AD) = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD) | \mathcal{F}^{RMBS}\right]$$

- Authors' interpretation of $\frac{\partial q^{RMBS}}{\partial AD} \approx 0$

$$q^{RMBS} = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD) | \mathcal{F}^{M} - \{AD\}\right]$$

Formally stating the maintained hypothesis

- By no-arbitrage,

$$q^{M}(AD) = \mathrm{E}\left[SDF^{M}(HPA) \times X(HPA; AD) | \mathcal{F}^{M}\right]$$
$$q^{RMBS}(AD) = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD) | \mathcal{F}^{RMBS}\right]$$

- Authors' interpretation of $\frac{\partial q^{RMBS}}{\partial AD} \approx 0$

$$q^{RMBS} = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD) | \mathcal{F}^{M} - \{AD\}\right]$$

- Holds always only if following are true:
  - $SDF^{M}(HPA) \propto SDF^{RMBS}(HPA)$ e.g. risk-neutrality

Formally stating the maintained hypothesis

- By no-arbitrage,

$$q^M(AD) = \mathrm{E}\left[SDF^M(HPA) \times X(HPA; AD) | \mathcal{F}^M\right]$$
$$q^{RMBS}(AD) = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD) | \mathcal{F}^{RMBS}\right]$$

- Authors' interpretation of $\frac{\partial q^{RMBS}}{\partial AD} \approx 0$

$$q^{RMBS} = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD) | \mathcal{F}^M - \{AD\}\right]$$

- Holds always only if following are true:
  - $SDF^M(HPA) \propto SDF^{RMBS}(HPA)$ e.g. risk-neutrality
    - Financial frictions + regulatory constraints $\Longrightarrow$ incomplete markets (different SDFs) for originators and investors

Formally stating the maintained hypothesis

- By no-arbitrage,

$$q^{M}(AD) = \mathrm{E}\left[SDF^{M}(HPA) \times X(HPA; AD)|\mathcal{F}^{M}\right]$$
$$q^{RMBS}(AD) = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD)|\mathcal{F}^{RMBS}\right]$$

- Authors' interpretation of $\frac{\partial q^{RMBS}}{\partial AD} \approx 0$

$$q^{RMBS} = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD)|\mathcal{F}^{M} - \{AD\}\right]$$

- Holds always only if following are true:
  - $SDF^{M}(HPA) \propto SDF^{RMBS}(HPA)$ e.g. risk-neutrality
  - $Y(HPA; AD) \propto X(HPA; AD)$ i.e. portfolio of securities is a linear claim on pool of mortgages

Formally stating the maintained hypothesis

- By no-arbitrage,

$$q^M(AD) = \mathrm{E}\left[SDF^M(HPA) \times X(HPA; AD) | \mathcal{F}^M\right]$$
$$q^{RMBS}(AD) = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD) | \mathcal{F}^{RMBS}\right]$$

- Authors' interpretation of $\frac{\partial q^{RMBS}}{\partial AD} \approx 0$

$$q^{RMBS} = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD) | \mathcal{F}^M - \{AD\}\right]$$

- Holds always only if following are true:
  - $SDF^M(HPA) \propto SDF^{RMBS}(HPA)$ e.g. risk-neutrality
  - $Y(HPA; AD) \propto X(HPA; AD)$ i.e. portfolio of securities is a linear claim on pool of mortgages
    - ★ Over-collateralization, MSRs, etc. – claim is concave

Formally stating the maintained hypothesis

- By no-arbitrage,

$$q^M(AD) = \mathrm{E}\left[SDF^M(HPA) \times X(HPA; AD) | \mathcal{F}^M\right]$$
$$q^{RMBS}(AD) = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD) | \mathcal{F}^{RMBS}\right]$$

- Authors' interpretation of $\frac{\partial q^{RMBS}}{\partial AD} \approx 0$

$$q^{RMBS} = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD) | \mathcal{F}^M - \{AD\}\right]$$

- Holds always only if following are true:
  - $SDF^M(HPA) \propto SDF^{RMBS}(HPA)$ e.g. risk-neutrality
  - $Y(HPA; AD) \propto X(HPA; AD)$ i.e. portfolio of securities is a linear claim on pool of mortgages
  - $\mathcal{F}^{RMBS} = \mathcal{F}^M \cup \{AD\}$ i.e. info sets are otherwise identical

Formally stating the maintained hypothesis

- By no-arbitrage,

$$q^M(AD) = \mathrm{E}\left[SDF^M(HPA) \times X(HPA; AD) | \mathcal{F}^M\right]$$
$$q^{RMBS}(AD) = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD) | \mathcal{F}^{RMBS}\right]$$

- Authors' interpretation of $\frac{\partial q^{RMBS}}{\partial AD} \approx 0$

$$q^{RMBS} = \mathrm{E}\left[SDF^{RMBS}(HPA) \times Y(HPA; AD) | \mathcal{F}^M - \{AD\}\right]$$

- Holds always only if following are true:
  - $SDF^M(HPA) \propto SDF^{RMBS}(HPA)$ e.g. risk-neutrality
  - $Y(HPA; AD) \propto X(HPA; AD)$ i.e. portfolio of securities is a linear claim on pool of mortgages
  - $\mathcal{F}^{RMBS} = \mathcal{F}^M \cup \{AD\}$ i.e. info sets are otherwise identical
    - Could investors just be more optimistic and have almost zero weight on region of biggest difference in payoffs?

Conclusion

- Paper completely convinced me that (1) appraisal bias exists, (2) that it is intentional, and (3) that it's quantitatively very important
- Paper made me doubt my prior that RMBS investors were aware of this.
- This may be the most plausible, but isn't the only plausible interpretation of the null RMBS pricing result.