Disagreement in Collateral Valuation

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Motivation

- *Central Question*: How does finance affect economic activity?
- *Important Channel*: Heterogeneous Beliefs
- Asset price determined by **buyers'** and **sellers'** beliefs
- If buyers finance purchase of asset with debt secured by the asset itself, **lenders'** beliefs affect asset price as well

Research Question(s)

- How do lenders distort prices of assets that serve as collateral?
- When does disagreement lead to momentum and reversal?
- What is the role of borrower risk?

Findings

Theoretical Findings

- Borrower riskiness mediates extent to which asset price reflects each agent's beliefs (contrast with risk aversion, wealth share, etc.)
- Asset price closer to lender's value when borrower riskier
- Price can *increase* in borrower riskiness when lender optimistic
- If lenders update slower than borrowers,
  - returns positively autocorrelated (momentum) and
  - momentum stronger when borrowers riskier

Empirical Findings

- Setting: U.S. residential real estate
- **Micro:** Price closer to appraisal when borrower/loan riskier
- **Macro:** Momentum stronger when borrowers/loans riskier

Literature

Disagreement and Heterogeneous Beliefs

Scheinkman and Xiong (2003), Berrada (2009), Banerjee and Kremer (2010), **Simsek (2013)**, Atmaz and Basak (2018), Kyle, Obizhaeva, and Wang (2023)

Collateral Valuation

Stroebel (2016), Jiang and Zhang (2023)

Momentum in Residential Real Estate

Case and Shiller (1989), Martel and Van Wesep (2016), Glaeser and Nathanson (2017), Guren (2018)

Overview

1. Static Model
2. Dynamic Model
3. Empirical Analysis

Static Model

Setup

- Asset for which agents have unit demand
- Borrowers pledge asset as collateral to finance purchase
- Lender finances fraction $\ell \in (0,1)$ of purchase price
- Borrower defaults (exogenously) with probability $\lambda \in (0,1)$
- λ represents *borrower riskiness* (ability to manage CFs, service debt)
- Borrower believes asset worth $a_{\mathcal{B}}$, lender $a_{\mathcal{L}}$, and borrower and lender "agree to disagree" about valuations

Equilibrium

- Zero-profit determines asset price $\boldsymbol{p(\lambda)}$, debt repayment $\boldsymbol{c(\lambda)}$:

$$\text{Borrower:} \quad (1-\ell)p(\lambda) = (1-\lambda)(a_{\mathcal{B}} - c(\lambda)) \tag{1}$$

$$\text{Lender:} \quad \ell p(\lambda) = \lambda a_{\mathcal{L}} + (1-\lambda)c(\lambda) \tag{2}$$

(values in default and solvency)

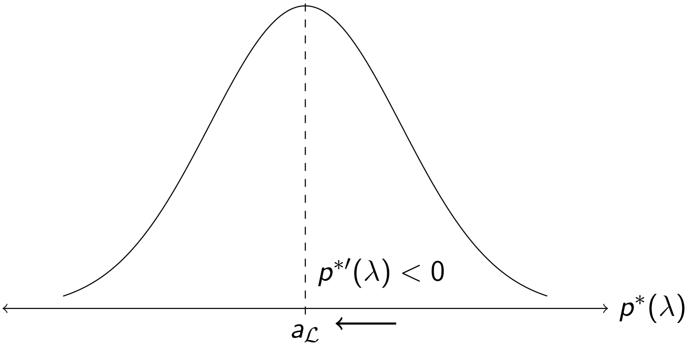
- Borrower riskiness mediates extent to which borrower, lender beliefs are reflected in asset price:

$$\boxed{p^*(\lambda) = \lambda a_{\mathcal{L}} + (1-\lambda)a_{\mathcal{B}}} \tag{3}$$

- Price decreasing in borrower riskiness when lender pessimistic, increasing when lender optimistic:

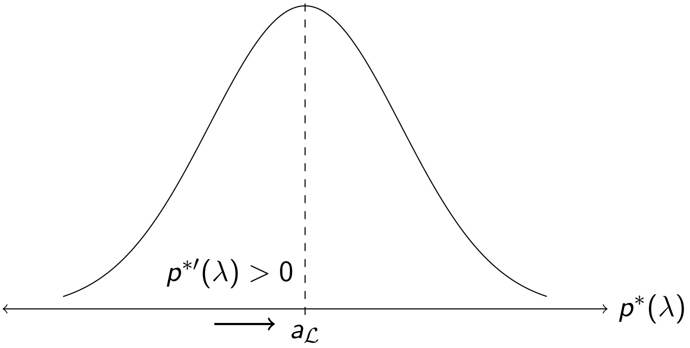
$$p^{*\prime}(\lambda) = a_{\mathcal{L}} - a_{\mathcal{B}} = (1-\lambda)^{-1}(a_{\mathcal{L}} - p^*(\lambda)) \tag{4}$$

Asset Price and Borrower Riskiness



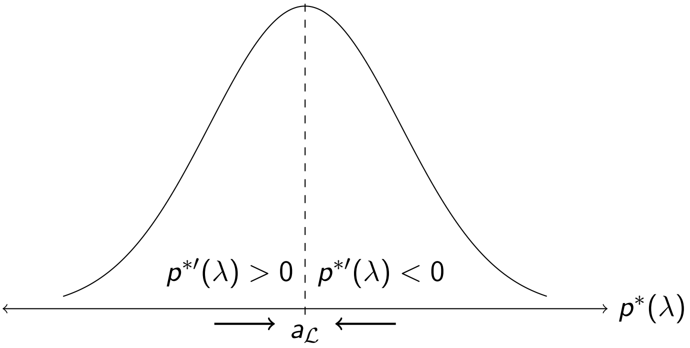
Lender Pessimistic ($a_{\mathcal{L}} < p^*(\lambda) \Leftrightarrow a_{\mathcal{L}} < a_{\mathcal{B}}$)**:** Lender requires lower price because pessimistic about collateral value

Asset Price and Borrower Riskiness



Lender Optimistic ($p^*(\lambda) < a_{\mathcal{L}} \Leftrightarrow a_{\mathcal{B}} < a_{\mathcal{L}}$)**:** Lender willing to accept higher price because optimistic about collateral value

Asset Price and Borrower Riskiness



Empirical Prediction: Difference between asset price and lenders' valuation should be smaller in riskier loans

Basic Insights Survive Extensions

Base model in paper considers trilateral bargaining between borrower/buyer, seller, and lender over the asset price and debt repayment (so seller's beliefs are reflected in the asset price as well)

- **Sequential Bargaining.** Borrower and lender bargain over loan terms before borrower bargains with seller over asset price
- **Repossession Costs.** Lenders only recover a fraction $\xi \in (0, 1)$ of the collateral value in the event of default
- **Endogenous Leverage.** Borrower and lender bargain over the fraction financed, $\ell \in (0, 1)$, instead of the repayment
- **Endogenous Default.** Borrower more likely to default when collateral value low
- **Secondary Market.** Lender sells loan to third-party investor (replace "lenders' beliefs" with "investors' beliefs")

Dynamic Model

Overview

- Need dynamic framework to think about evolution of returns
- In this version of the model, agents disagree about valuations because they place different weights on new information
- E.g., borrowers place 25% on new information, lenders 15%, Bayesians 20%, and borrowers and lenders agree to disagree
- New features relative to static model:
    - Estimates of value based on historical data
    - Uncertainty about the arrival time of default
    - Recovery values based on market prices for the asset
    - Notions of "momentum" and "reversal" in returns

Information Environment

- Time is continuous and indexed by $t \in (-\infty, \infty)$
- $\boldsymbol{V_t}$ is borrowers' publicly observable stock value for asset
- V_t evolves with latent, mean-reverting drift $\boldsymbol{X_t}$ (OU process)
- $\boldsymbol{\widehat{X}_t^j}$ is agent j's expectation of X_t
- Restrict attention to linear filters
- Agent j places weight $\boldsymbol{w_j}$ on new info (i.e., on $dV_t - \widehat{X}_t^j dt$)
- Let w_0 denote the Bayesian weight (KB filter)
- E.g., if $w_j < w_0$, then j *under*-weights new info (too slow)

Financing

- All players are risk-neutral, use common discount rate
- Consider borrower who buys the asset at time t
- As before, lender finances fraction $\ell \in (0, 1)$ of purchase price
- Default time $\boldsymbol{T} > t$ arrives exogenously with rate $\lambda > 0$
- As before, we interpret λ as borrower riskiness
- Borrower pays (unmodelled) seller $\boldsymbol{P_t}$ seller for asset
- Borrower makes lender fixed repayment until default
- Equilibrium price and repayment determined by zero-profit

Equilibrium Price

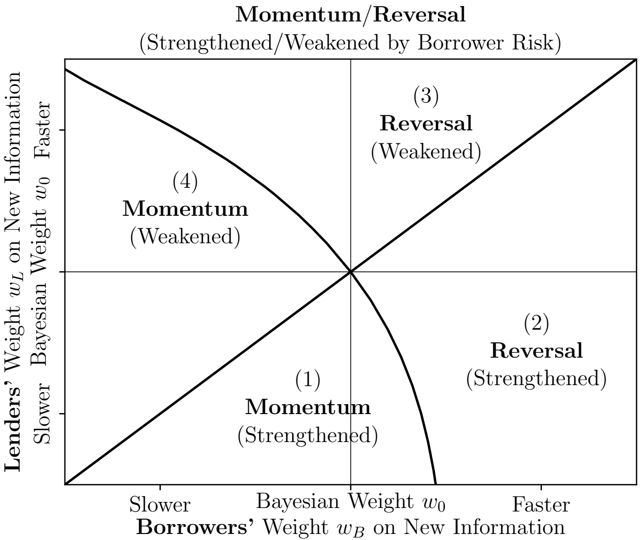
- The equilibrium price is

$$\boxed{P_t^* = V_t + c_{\mathcal{B}}(\lambda)\widehat{X}_t^{\mathcal{B}} + c_{\mathcal{L}}(\lambda)\widehat{X}_t^{\mathcal{L}}} \tag{5}$$

where $c'_{\mathcal{B}}(\lambda) < 0$ and $c'_{\mathcal{L}}(\lambda) > 0$

- As in the static model,
  - The riskier the borrower, the more the lender's belief is reflected in the price
  - The difference between the price P_t and the lenders' estimate of value A_t is smaller when the borrower is riskier

Return Autocorrelation in Equilibrium



Return Autocorrelation in Equilibrium

- *Analytical Result*: If lenders update more slowly than borrowers and borrowers update like Bayesians ($w_{\mathcal{L}} < w_{\mathcal{B}} = w_0$), then returns are positively autocorrelated and autocorrelation is strongest when borrowers are most risky
- *Intuition*: Prices are pulled towards lenders' slowly updating beliefs, causing return predictability
- Numerically, log price changes appear to be positively autocorrelated when borrowers are sufficiently risky
- Dynamic model illustrates importance of disagreement (cannot get return autocorrelation in RE framework)

Residential Real Estate

Residential Real Estate

- We use U.S. residential real estate market as laboratory
- Can observe
  1. asset prices (i.e., sale prices of homes)
  2. lenders'/investors' collateral valuations (i.e., appraisals)
  3. measures of borrower/loan riskiness (e.g., FICO, LTV)
- Collateral value uncertain, disagreement likely

Real Estate Part I:

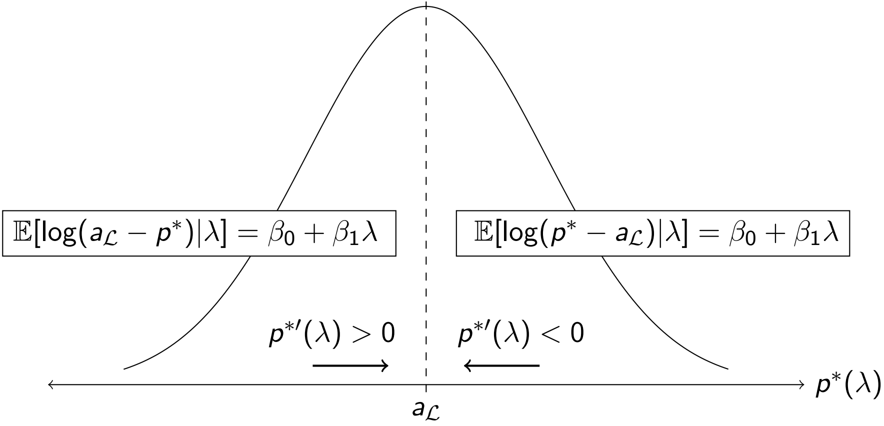
Prices, Appraisals, and Borrower Risk

Sale Price and Appraisals

- **Theory:** Price closer to appraisal when default risk higher
- Equity, LTV, and FICO score at origination strong predictors of default (Jones and Sirmans, 2015)
- **Data:** CoreLogic Loan-Level Market Analytics (loan-level; appraised value, sale price, equity, LTV, FICO)
- *Identifying Assumption:* Other determinants of difference between appraisal and price uncorrelated with default risk

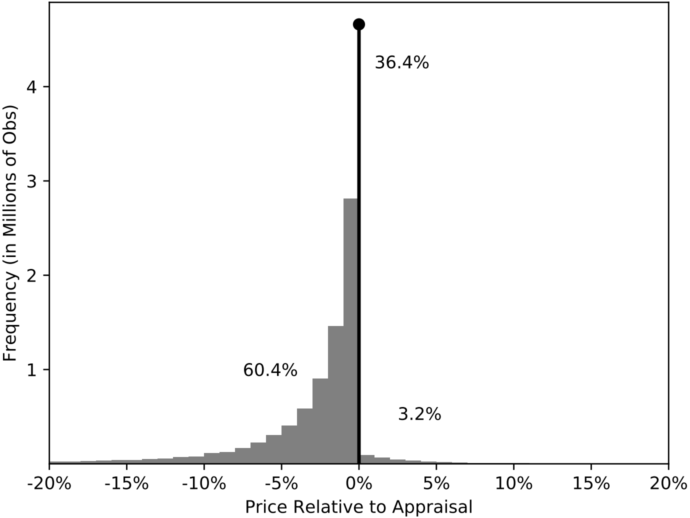
Asset Price and Borrower Riskiness

Regression: "appraisal-adjusted" price on measures of default risk



β_1 should load with **negative** sign on both sides of the distribution

Sale Price and Appraisals



Appraisal, Price, and Default Risk (Poisson)

Price ≤ Appraisal

	Appraisal − Price			
log(Equity)	-0.079***			
	(0.005)			
LTV		-0.058***		
		(0.008)		
FICO			-0.060***	
			(0.008)	
PC1				-0.120***
				(0.007)
Z×Y×M FE	×	×	×	×
Pseudo R^2	37.2%	34.9%	35.7%	36.3%
Observations	20,095,354	20,095,354	12,318,206	12,318,206

(Z)IP×(Y)ear×(Q)uarter fixed effects, clustered standard errors

Appraisal, Price, and Default Risk (Poisson)

Price ≥ Appraisal

	Price − Appraisal			
log(Equity)	-1.967***			
	(0.098)			
LTV		-0.055		
		(0.048)		
FICO			-0.016	
			(0.081)	
PC1				-0.771***
				(0.051)
Z×Y×M FE	×	×	×	×
Pseudo R^2	72.2%	45.1%	45.0%	50.3%
Observations	3,524,647	3,524,647	1,532,085	1,532,085

(Z)IP×(Y)ear×(Q)uarter fixed effects, clustered standard errors

Repossession Costs and Recovery Values

- Two (related) issues:

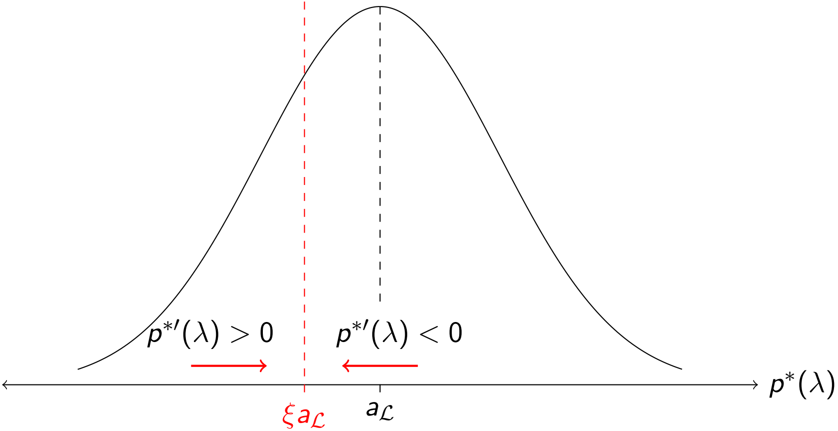
  1. Lenders do not receive full price of house upon reposession (Conklin et al. (2023) estimate 5-6% foreclosure discount)

  2. House prices negatively correlated with default

- *Solution:* Discount appraised value by fixed amount (5%, 10%)

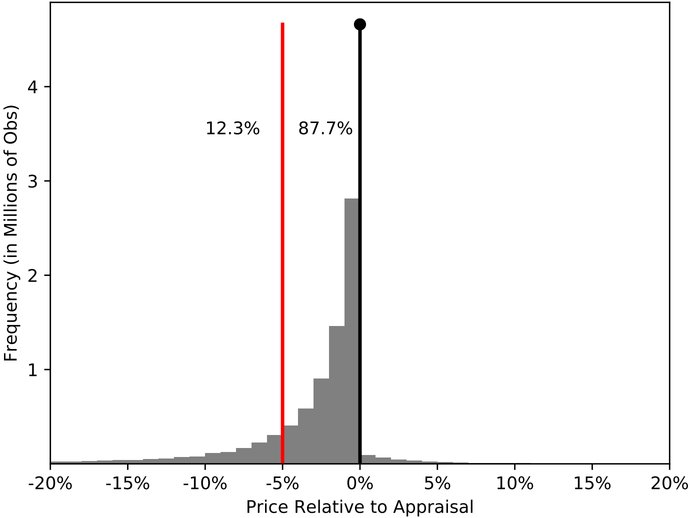
Repossession Costs and Recovery Values

Suppose lender obains fraction $\xi \in (0,1)$ of value in default



According to model extension, simply replace "$a_{\mathcal{L}}$" with "$\xi a_{\mathcal{L}}$"

Price Relative to 95% of Appraised Value



Repossession Cost Adjustment (Poisson)

Price $\leq$ 95% $\times$ **Appraisal**

	95% × Appraisal − Price			
log(Equity)	-0.141***			
	(0.006)			
LTV		-0.144***		
		(0.005)		
FICO			-0.072***	
			(0.009)	
PC1				-0.166***
				(0.008)
Z×Y×M FE	×	×	×	×
Pseudo R^2	62.0%	61.8%	60.4%	61.0%
Observations	1,489,309	1,489,309	958,997	958,997

(Z)IP×(Y)ear×(Q)uarter fixed effects, clustered standard errors

Repossession Cost Adjustment (Poisson)

Price $\geq$ 95% $\times$ **Appraisal**

	Price − 95% × Appraisal			
log(Equity)	-0.313***			
	(0.026)			
LTV		-0.128***		
		(0.006)		
FICO			-0.064***	
			(0.006)	
PC1				-0.244***
				(0.005)
Z×Y×M FE	×	×	×	×
Pseudo R^2	72.4%	62.9%	65.5%	69.0%
Observations	19,292,239	19,292,239	11,485,196	11,485,196

(Z)IP×(Y)ear×(Q)uarter fixed effects, clustered standard errors

Results Survive Robustness Checks

1. **Resalable Loans.**
   - Why "disagree" with borrower if loan resold anyway?
   - *Solution:* Subsample on conforming loans

2. **Appraisal Bias.**
   - Evidence that appraisers bias upwards (e.g., Eriksen et al. (2020); bias stronger for higher LTV loans (Agarwal, Ben-David, and Yao, 2015), biases us against finding results)
   - *Solution:* Subsample on $\textit{Appraisal} > 105\% \times \textit{Price}$, which should be less affected by appraisal bias

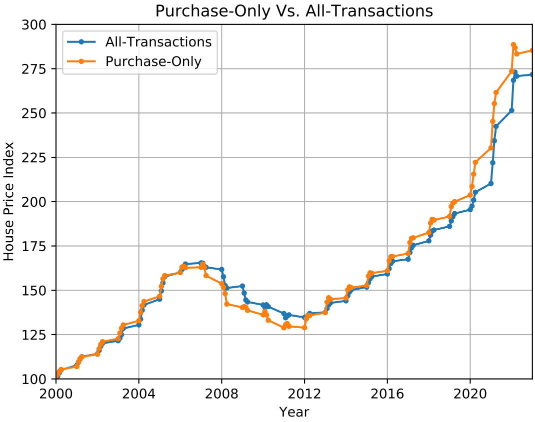
Real Estate Part II:

Momentum and Borrower Risk

Appraisals Update Too Slowly

- To recover time-trends, Bayesian inference requires some weight placed on past "comparable" transactions
- However, appraisers over-weight past appraisals (Clayton, Geltner, and Hamilton, 2001), suggesting a deviation from Bayes' rule (similar to Murfin and Pratt, 2019)
- Known as the "tyranny of past values" (Geltner, 1991)

Appraisals Update Too Slowly



All-transactions index, which includes appraised values, lags purchase-only index (reproduced from Martel and Van Wesep (2016))

Return Autocorrelation

- **Theory:** momentum *stronger* when default risk *higher*
- **Data:** FHFA (prices levels) and Freddie Mac (risk measures), both at CBSA$\times$Year$\times$Quarter-level
- **Regression:** Standard price-predictability regression (e.g., Guren (2018)) with borrower/loan risk interaction:
    1. Perform within-CBSA sort of quarters by borrower/loan risk
    2. Regress log-price changes on lagged log-price change, interacted with lagged borrower/loan risk level

Annual Autocorrelation of Log Price Changes

	No Sort	log(Equity)	LTV	FICO	PC1
ρ	0.68***				
	(0.08)				
$\rho \times$ Low		0.79***	0.56***	0.78***	0.90***
		(0.10)	(0.09)	(0.12)	(0.12)
$\rho \times$ Mid		0.73***	0.72***	0.65***	0.78***
		(0.09)	(0.09)	(0.07)	(0.09)
$\rho \times$ High		0.58**	0.93**	0.58**	0.52**
		(0.11)	(0.17)	(0.18)	(0.08)
Adjusted R^2	41.4%	42.3%	43.6%	42.1%	44.1%
Observations	8,772	8,772	8,772	8,772	8,772

Conclusion

- Develop model in which borrowers, lenders agree to disagree about value of collateral
- Illustrate potentially distortionary effect of lenders' beliefs on prices, returns of assets that serve as collateral
- Establish connection between momentum, borrower riskiness
- Demonstrate empirical relevance for U.S. residential real estate, though insights applicable to other asset classes as well

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