The Cost of Servicing Debt Pools

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The Architecture of Secondary Loan Markets

$13 trillion global securitized market, nearly triple the size of securitized market in 2008

- Dominated by debt, pooled together, tranched, and sold to investors
- Global Financial Crisis highlighted some tradeoffs
  - More credit access vs. moral hazard from "originate to distribute" incentive
  - Understated risk of loss and inflated credit ratings
- Solution post-2009: over-collateralization, risk retention rules, reporting requirements, and risk weighting for mortgage-backed securities
- **Are we done, and securitization works as well as possible?**

Our hypothesis: No! Design of secondary market *still* impacts the primary market.

1. How are servicing fees set and what consequences do they have for borrowers and investors?

Debt Servicers' Incentives

Pools of loans are assigned to servicers with misaligned incentives

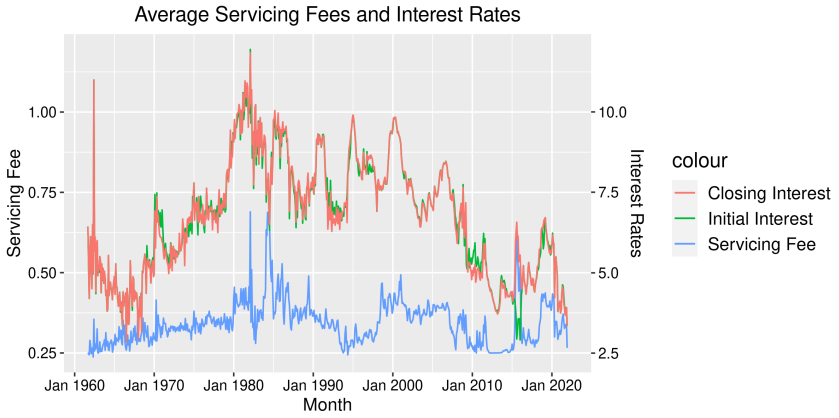
- Servicers collect payments and pass them through to investors
- Borrowers facing default turn to servicer for relief first
- **Servicer incentive for leniency**: earn *servicing fees* as fraction of outstanding principal if loan survives
- **Servicer incentive for strictness**: *advance payments* on behalf of defaulted borrower that cannot be recovered til foreclosure, prepayment or cure

Key determinant of borrower and investor welfare → **cost of advances net of servicing fee**

Data

- Non-Agency Residential MBS loan level data
  - Origination and performance data
  - Covers 95% of the non-agency market
  - Unique features of the data
    - Loan-level characteristics, with servicer identified
    - Include deal and pool ID, which can be connected to CUSIP
  - Cover originations between 2000-2007
  - Very few NARMBS post-financial crisis
- Bloomberg data on NARMBS
  - Gathered price, coupon, maturity, and other characteristics on CUSIPs associated with NARMBS sample
  - Calculated Yield to Maturity as a measure of investor return

Data



- Servicing fee is a fraction of total outstanding principal, around .25% to .5%
- Investor gets about 20x the compensation of servicers

How Pools Set Servicing Fees

Hypothesis: Servicing Fees Set at Average Cost

1. Decompose servicing fee by regressing on fixed effects - R^2 table to follow
   - Including only the deal $\times$ pool fixed effects alone, explains 67.5% of the variation in servicing fee
   - Most incremental explanatory power from deal and pool
   - Little additional variation from zip code, loan type, credit score, DTI, LTV

2. Each pool must break even in expectation, so assume pricing as follows

$$P_{dp} = AC_{dp} + \epsilon = loss'_{dp}\beta_{loss} + \epsilon$$

   - P_{dp} is the servicing fee for an individual deal-pool
   - AC_{dp} is the cost of servicing that deal-pool
   - $loss_{dp}$ is a vector of variables that determine servicers' costs, including risk of default or prepayment
   - β_{loss} are linear coefficients on losses, assuming that cost varies linearly with loss
   - Error ϵ has mean 0 and is uncorrelated with P_{dp}

Servicing Fee Decomposition - R^2 Table

	Deal	Pool	Orig	Serv	Month	Zip	Loan Type	FICO	DTI	LTV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
R-Squared (%)	65.4	67.6	69.3	70.7	70.8	70.9	70.9	71	71	71.3
Adj R-Squared	65.4	67.5	69.2	70.6	70.6	70.7	70.7	70.7	70.7	71.2
Deal F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
xPool F.E.		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
xOrig F.E.			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
xServ F.E.				Yes	Yes	Yes	Yes	Yes	Yes	Yes
+Month F.E.					Yes	Yes	Yes	Yes	Yes	Yes
+Zip F.E.						Yes	Yes	Yes	Yes	Yes
+Loan Type F.E.							Yes	Yes	Yes	Yes
+FICO								Yes	Yes	Yes
+DTI									Yes	Yes
+LTV										Yes
Obs (millions)	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8

Estimating the Cost of Servicing

1. Limit data to fixed price deals for simplicity
2. *(Average Cost Pricing Function:)* Set relevant loss variables to default and prepayment

$$P_{dp} = K + \beta_1 Default_{dp} + \beta_2 Prepay_{dp} + \beta_3 Default_{dp} \times Prepay_{dp} + \epsilon_{dp}$$

   - Under assumptions, measures cost of servicing at the deal pool (dp) level – meaning the relationship between default/prepayment risk and fee – plus markup K

3. Calculate loan level $\widehat{Default}_i$ and $\widehat{Prepay}_i$ by regressing actual default and prepayment on loan characteristics

$$loss_i = \gamma_j X_{ij} + \epsilon_i$$

4. Solve for marginal cost of servicing loan as

$$\widehat{MC}_i = K + \beta_1 \widehat{Default}_i + \beta_2 \widehat{Prepay}_i + \beta_3 \widehat{Default}_i \times \widehat{Prepay}_i + \epsilon_i$$

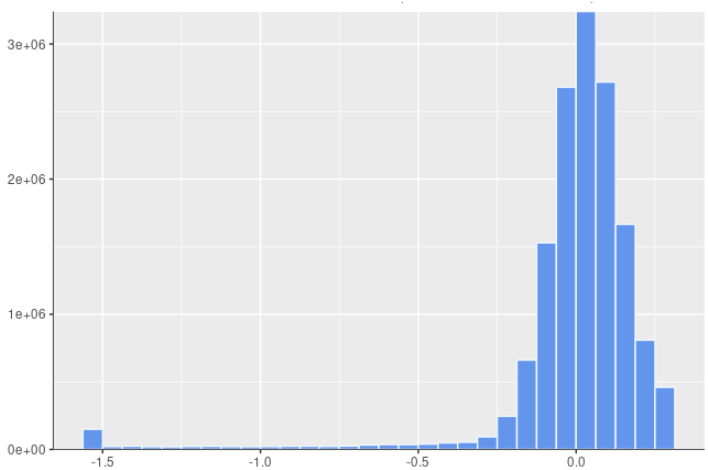
Estimating the Cost of Servicing

- According to our *Pricing Function*:
  - Servicing fees should not be uniform
  - Should vary across loans with higher prepayment & default risks
  - Decompose average servicing cost into loss variables, default and prepayment, then calculate marginal cost from loan characteristic prediction
  - Difference between $\widehat{MC}_i$ and P_i determines the net cost of servicing a particular loan within a deal-pool

Dependent Variable:		fee	
Model:	(1)	(2)	(3)
Variables			
Constant	0.2863***	0.2302***	0.1315***
	(0.0027)	(0.0068)	(0.0078)
Fraction Default	0.2698***		0.2474***
	(0.0080)		(0.0245)
Fraction Prepaid		0.1837***	0.2234***
		(0.0098)	(0.0105)
Frac Default * Frac Prepaid			0.0903**
			(0.0391)
Fit statistics			
Observations	5,650	5,650	5,650
R^2	0.16650	0.05813	0.26130
Adjusted R^2	0.16636	0.05796	0.26091

IID standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Distribution of Net Cost



- A long tail of low net cost loans is subsidizing a large mass of high cost loans

Borrower Level Results

Borrower Level Results

1. By construction, variation in deal-pool net cost is quasi-random
   - Absent a rule constructing a pool of securitized loans according to cost of servicing, being pooled with another loan is quasi-random.
   - Since a single fee is set for a pool, then unless the pool is constructed to narrow the spread of the servicing fee, borrower distance above or below the average is quasi-random
   - Thus, the regression results isolate the effect on a borrower's outcomes of being pooled with someone who has a higher or lower net cost.

2. Test null hypothesis that individual level variation within pool does not drive foreclosure and modification behavior

Individual Level Empirical Specification

At the individual borrower level i

$$Y_i = \beta Net\_Cost_i + \delta \boldsymbol{X_i} + \mu_i + \nu_i + \gamma_i + \epsilon_i$$

- Y_i = Individual level outcome conditional on 30 DPD within 1 year
  - Foreclosure
  - Modification
- Net_Cost_i Individual level MC - actual servicing fee
- $\mu_i,\ \nu_i,\ \gamma_i$ are State, Servicer-Originator, Deal-Pool fixed effects
- $\boldsymbol{X_i}$ Includes FICO, LTV, DTI, Closing Balance, and indicators for Orig_year and Product_type
- ϵ_i = error term

Individual Level Regression Results

Dependent Variable:			Foreclosed				Modified	
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables								
Net Cost	0.6942***	0.6360***	0.6778***	0.6217***	-0.0824***	0.0191	-0.3336***	-0.3589***
	(0.0179)	(0.0419)	(0.0421)	(0.0463)	(0.0098)	(0.0366)	(0.0454)	(0.0459)
FICO			0.0003***	0.0003***			-0.0006***	-0.0006***
			(2.66×10^{-5})	(2.69×10^{-5})			(3.32×10^{-5})	(3.39×10^{-5})
LTV			-0.0004***	-0.0001			-0.0006**	-0.0005*
			(0.0001)	(0.0001)			(0.0003)	(0.0003)
DTI			0.0003***	0.0002***			0.0006***	0.0005***
			(5.58×10^{-5})	(5.97×10^{-5})			(5.48×10^{-5})	(5.09×10^{-5})
CLOSE_BAL				2.42×10^{-7}***				1.09×10^{-7}***
				(1.72×10^{-8})				(1.48×10^{-8})
Orig_year Indicators								
Product_type Indicators								
Fixed-effects								
STATE		Yes	Yes	Yes		Yes	Yes	Yes
SVC_CODE-ORIG_CODE		Yes	Yes	Yes		Yes	Yes	Yes
DEAL_NO-POOL_ID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics								
Observations	2,271,696	2,271,696	2,271,696	2,271,696	2,271,696	2,271,696	2,271,696	2,271,696
R^2	0.08901	0.09822	0.10952	0.11423	0.09893	0.11158	0.11948	0.12069
Within R^2	0.00745	0.00564	0.01809	0.02330	0.00013	6.51×10^{-6}	0.00889	0.01025

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Individual Level Results Discussion

- Utilize Foreclosure & Modification conditional on 30 days past due (DPD)
- Borrowers with more under-pricing experience more foreclosures and fewer modifications
- Conditional on loans entering 30 DPD, a 1 unit increase in Net_Cost leads to:
  - 62.17 pp $\uparrow$ in foreclosure
  - 35.89 pp $\downarrow$ in modification
- Consistent with servicers reacting to incentives - *moral hazard*

Investor Level Results

Investor Level Results

1. Aggregate individual level net cost to the deal-pool level
   - By construction, variation in deal-pool net cost is quasi-random
     - ie, random variation relative to the mean
   - Test null hypothesis that individual level variation within pool does not impact deal-pool level losses, leaving investors unaffected
2. Test effect of costs on investor returns
   - Use Bloomberg data on yield for CUSIPs connected to each deal
   - Check whether net cost at the deal level impacts yield, conditional on observables

Investor Level Empirical Specification

At the Deal Pool (DP) level d

$$Y_d = \beta Net\_Cost_d + \mu_d + \epsilon_d$$

- Y_d = DP level outcome conditional on 30 DPD within 1 year
  - Foreclosure
  - Modification
- $Net\_Cost_d = Net\_Cost_d$ = Average of individual Net_Cost_i in deal-pool
- μ_d = DP origination year fixed effect
- ϵ_d = error term
- Include FICO, LTV, DTI, Closing Balance in robustness tests, robust standard errors

Modification and Foreclosure Results

Dependent Variables:	Modified	Foreclosed
Model:	(1)	(2)
Variables		
Net Cost	-0.0425***	0.1251***
	(0.0118)	(0.0211)
Orig Year FE	Yes	Yes
Fit statistics		
Observations	5,619	5,619
R^2	0.29090	0.47471
Within R^2	0.00763	0.00841

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

- -4.25 pp ↓ in Modifications
  - Consistent with servicers reducing loan modifications
- 12.5 pp ↑ in Foreclosure
  - Consistent with servicers foreclosing fast on a defaulted loan to reduce exposure to advance payments

Asset Pricing Implications

- Asset pricing implications
- The results indicate that foreclosures increase and modifications decrease on more underpriced loans
- This may be rational behavior for the servicers, but how does it affect investors?
- To understand this, we study prices and cashflows on the MBS backed by these loans

Asset Pricing Empirical Specification

At the Deal level d

$$Y_{d,(t)} = \beta Net\_Cost_d + \boldsymbol{\delta X_d} + \lambda Coupon_{d,(t)} + \epsilon_{d,(t)}$$

- Y_d = Deal level outcome variable
  - $\log(price_{d,0})$ - where price is the first price observed
  - $\log(price_{d,t})$ - time varying price
  - $r^{CF}_{d,t}$ - interest cash flows reported in Bloomberg, scaled by previous period outstanding balance
  - $YTM_{d,t}$ - deal level average yield to maturity
- Net_Cost_d = Average of individual Net_Cost_i in a deal
- $\boldsymbol{X_d}$ = Include deal & loan char & $\log(price_{d,0})$ for $\log(price_{d,t})$
- Coupon is first coupon for $\log(price_{d,0})$ time varying for other vars
- ϵ_d = error term
- Robust or clustered standard errors

Regression Results

Dependent Variables:	log_price_0	log_rcf	log_price	ytm
Model:	(1)	(2)	(3)	(4)
Variables				
Net Cost	0.0745***	-1.862***	0.3663***	-0.1297***
	(0.0120)	(0.0391)	(0.0161)	(0.0046)
Coupon		-0.0001***	2.16×10^{-5}***	-9.25×10^{-6}***
		(2.87×10^{-5})	(7.92×10^{-6})	(2.93×10^{-6})
log_price_0			0.3755***	
			(0.0101)	
Loan Characteristics	Yes	Yes	Yes	Yes
Deal Characteristics	Yes	Yes	Yes	Yes
FICO	0.0051***	-0.0039***	-0.0018***	0.0006***
	(5.26×10^{-5})	(0.0004)	(0.0002)	(4.45×10^{-5})
DTI	0.0008***	-0.0022***	-0.0007***	-0.0004***
	(4.94×10^{-5})	(0.0002)	(6.06×10^{-5})	(2.07×10^{-5})
LTV	-0.0092***	-0.0084***	-0.0120***	-0.0024***
Reg. Level	Deal	Deal	Deal	Deal
Fixed-effects				
date	Yes	Yes	Yes	Yes
Fit statistics				
Observations	790,832	826,978	246,455	232,604
R^2	0.25225	0.13891	0.29250	0.27593
Within R^2	0.21277	0.06867	0.21567	0.13290

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

First Price Results

- Deals with $\uparrow$ servicing costs $\Rightarrow \uparrow$ initial price
- Controls include deal level loan characteristics, types, locations
- Suggests that investors think they achieve cost savings by paying the servicer less
  - Tradeoff between getting a bargain and powering servicer incentives

Cash Flow Return Results

- Cash Flow Return (r_t^{CF}) calculated as:

$$r_t^{CF} = \frac{Principal_t + Interest_t}{Principal_{t-1}}$$

- $\uparrow$ servicing cost $\Rightarrow \downarrow$ cash flow returns
- Controls include deal level loan characteristics, types, locations
- Suggests that servicer underpricing reduces investor cash flow
  - Tradeoff between getting a bargain and powering servicer incentives

Concurrent Price Results

- Deals with $\uparrow$ servicing costs $\Rightarrow \uparrow$ concurrent price
- Controls include deal level loan characteristics, types, locations
- Suggests that investors think they achieve cost savings by paying the servicer less
  - Tradeoff between getting a bargain and powering servicer incentives

Yield to Maturity Results

- YTM calculated from the following equation:

$$Price_t = \sum_{t}^{T} \frac{Principal_t + Interest_t}{(1 + YTM)^t}$$

- Price, Principal, Interest reported in Bloomberg at CUSIP level, aggregated to deal level
- Calculate average YTM at deal level
- $\uparrow$ servicing cost $\Rightarrow \downarrow$ yields
- Controls include loan characteristics, types, locations
- Suggests that investors are worse off when deal level servicing fees are set too low
  - Tradeoff between getting a bargain and powering servicer incentives

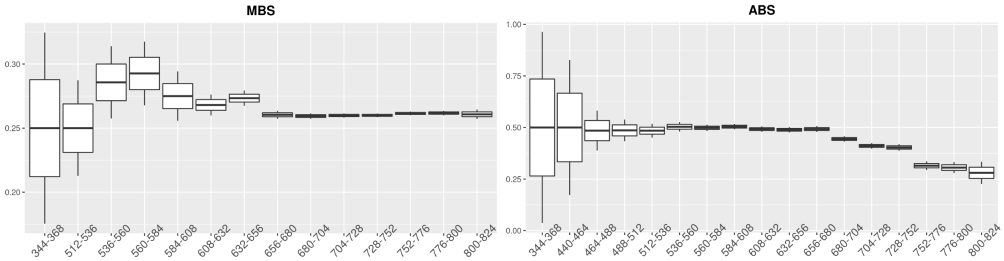
Discussion

- Servicing fees primarily set at the deal level, consistent with average cost
- Calculate predicted net marginal cost of servicing based on pricing equation
- Borrowers with high cost loans within pool experience higher foreclosure rate and fewer modifications
- Reflects in investor returns
  - Higher net cost deals have more foreclosures, fewer modifications, lower yields
- **Pricing pools instead of individual loans redistributes across borrowers and impacts investor welfare**

Appendix

Downward Trend in Fee by FICO Across Groups

Consistent with high credit score borrowers being easier to service



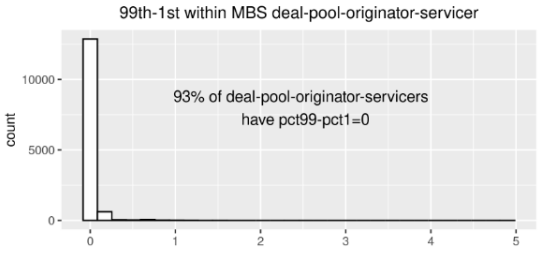
(a) MBS (Prime)

(b) ABS (Subprime & Alt-A)

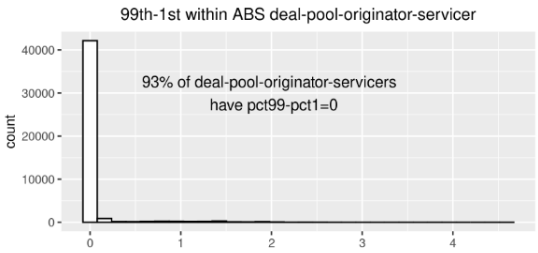
Nearly Zero Fee Dispersion Within Groups of Loans

Servicing fee on 99^{th} pct loan minus servicing fee on 1^{st} pct loan

- Within Deal-Pool-Originator-Servicer group
- Majority have zero fee dispersion



(c) MBS (Prime)

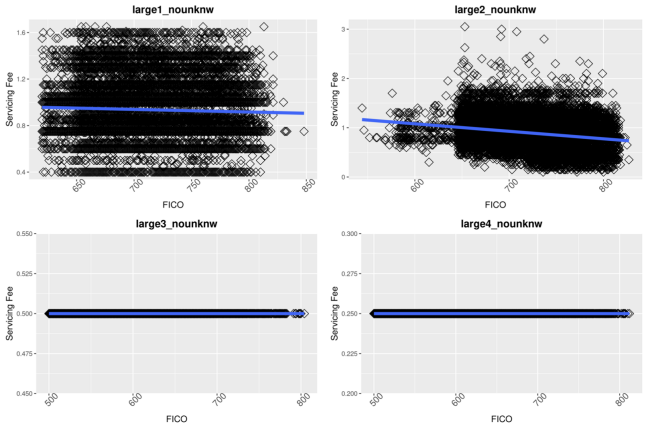


(d) ABS (Subprime & Alt-A)

Explore Whether Large vs. Small Servicers Vary in Fee Dispersion (Large)

Rank DPOS by number of loans select 4 Largest Groups

- Dispersion in Servicing Fee within DPOS Groups Originators or Servicers
- More dispersion for 2 of 4 servicers consistent with a more refined pricing model

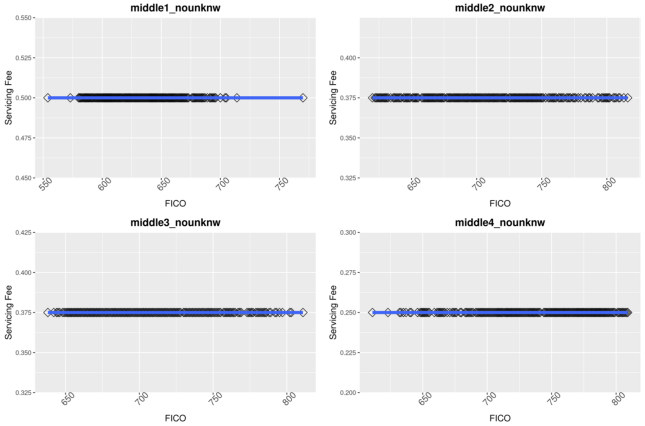


(e) 4 Largest Groups

Explore Whether Large vs. Small Servicers Vary in Fee Dispersion (Middle)

Rank DPOS by number of loans select 4 Middle Groups

- Dispersion in Servicing Fee within DPOS Groups Originators or Servicers

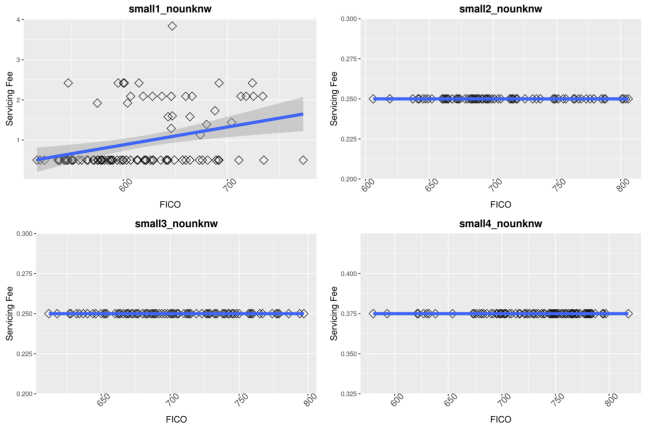


(f) 4 Middle Groups

Explore Whether Large vs. Small Servicers Vary in Fee Dispersion (Small)

Rank DPOS by number of loans select 4 Small Groups

- Dispersion in Servicing Fee within DPOS Groups Originators or Servicers



(g) 4 Small Groups