

The Impact of Skin in the Game on Bank Behavior in the Securitization Market

Martin Hibbeln & Werner Osterkamp

University of Duisburg-Essen

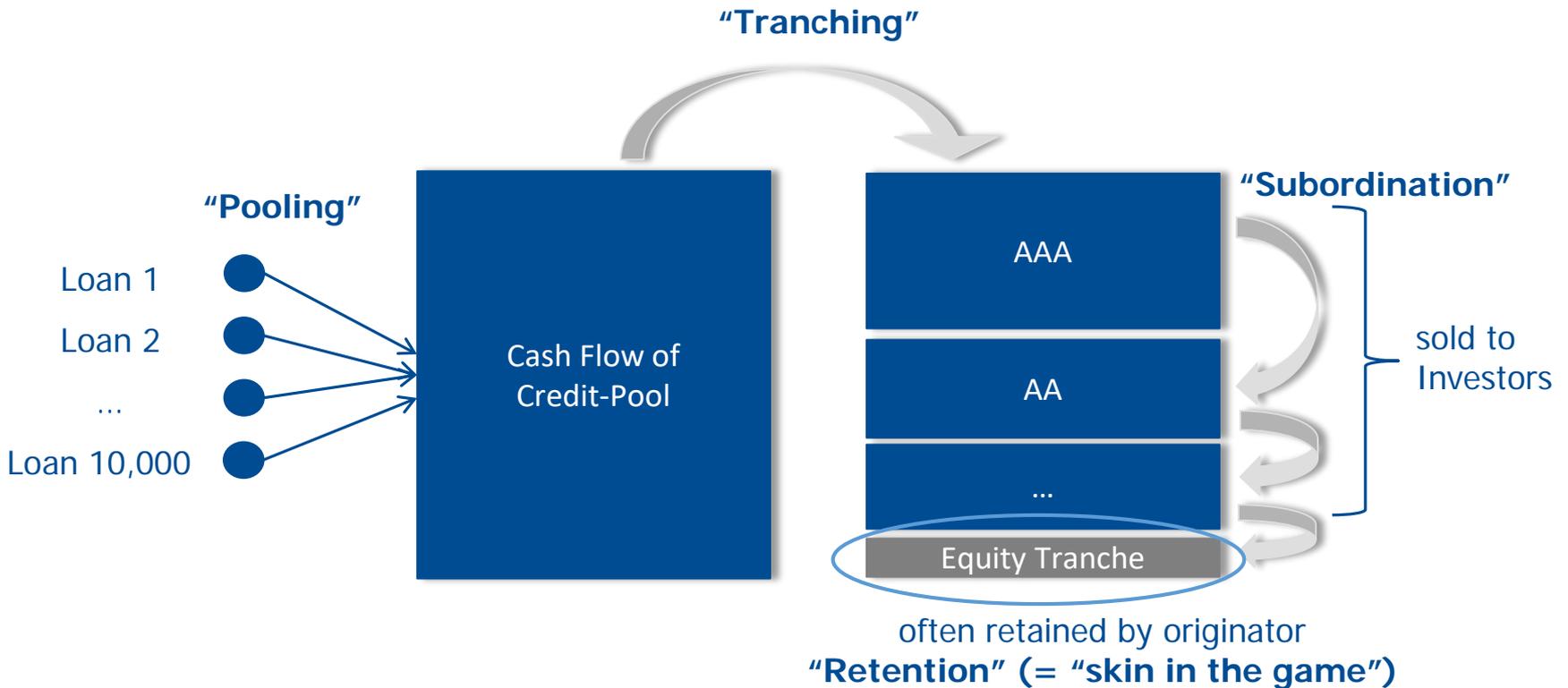
Financial System of the Future

Federal Reserve Bank of Atlanta

October 31st 2019

Typical structure of asset-backed securities (ABS)

- Pooling
- Tranching/Subordination
- Retention (= “skin in the game”)



Problem

- **Securitizations enable banks to lend money almost without bearing credit risk**
 - Informational asymmetries between originator and investors
 - Incentive problems of originators
- **Design of securitizations contributed to financial crisis**
 - Lower screening and monitoring effort
 - Selection of bad quality loans for securitizations
 - Resulting losses had to be borne by investors

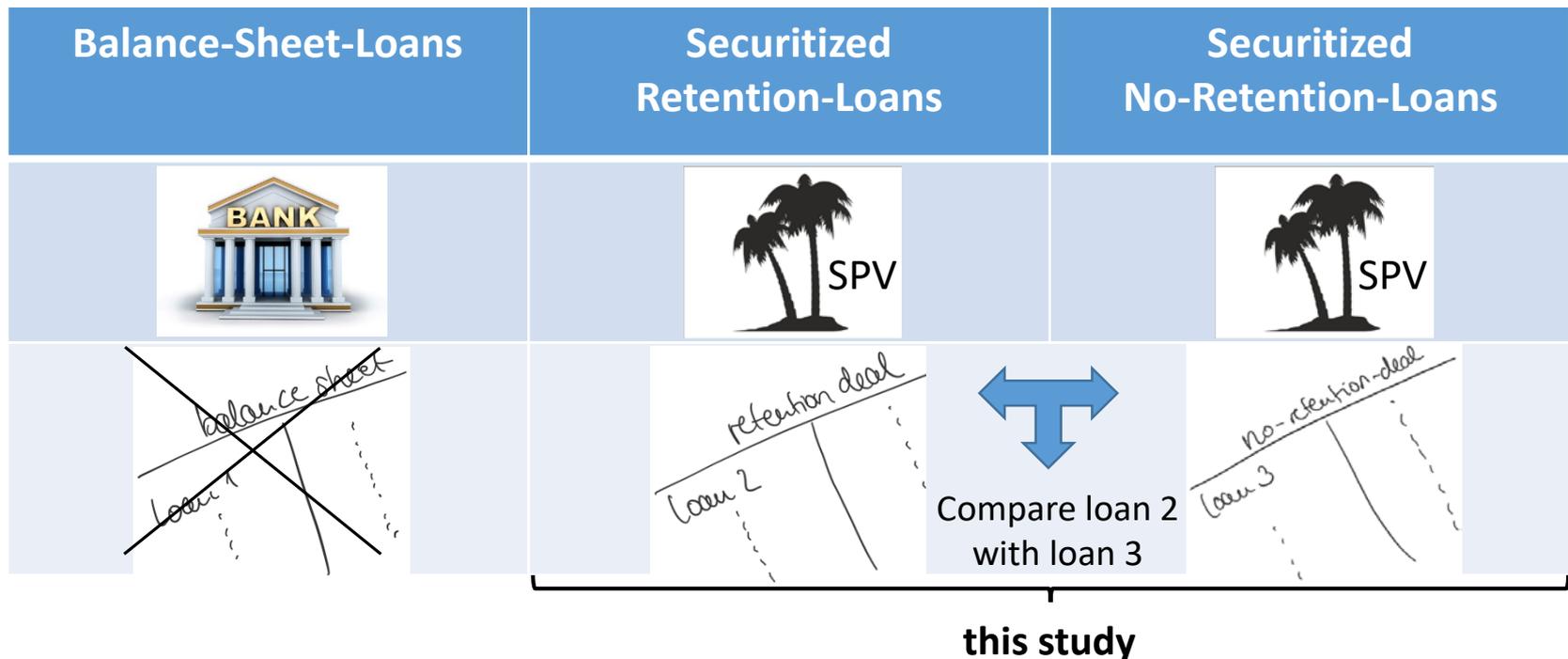
EU regulation: “Skin in the game”

- **Credit risk assessment in securitizations has to correspond to balance sheet loans**
 - Aims to improve screening effort (but not monitoring)
- **EU minimum retention requirement (since 2011):**
Originators have to retain a material fraction of the deal (= **5% retention**) to harmonize the interests of banks and investors.

1 Introduction

Research questions

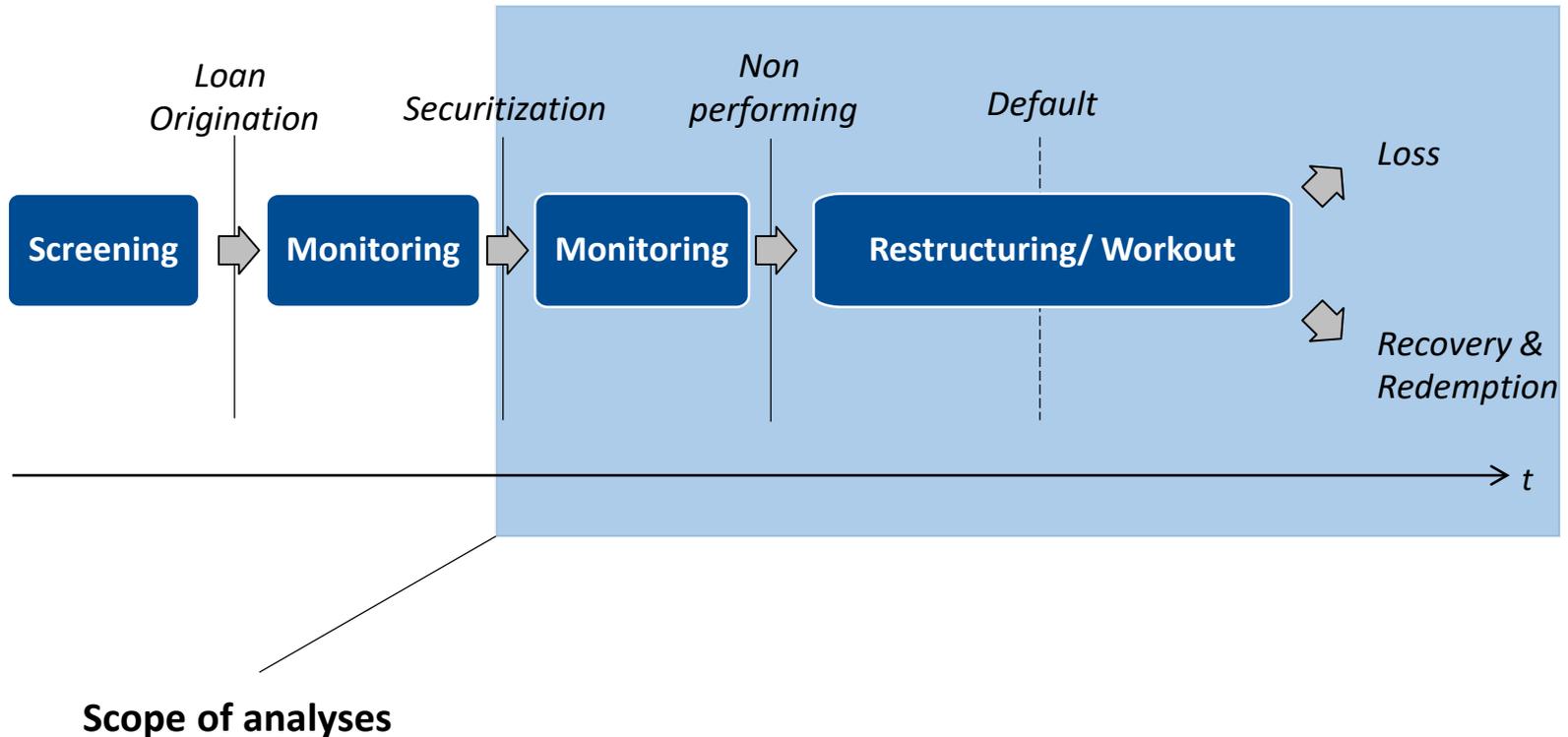
- Does retention lead to better loan performance?
- If yes, what are the components/channels for the improved performance?
- Do banks treat securitized loans differently if they have “skin in the game”?
difference regarding: I) screening? II) monitoring? III) workout process?



1 Introduction

Analyses: Incentive problems in the credit process

Based on loan level data, we analyze incentive problems of retention- vs. no-retention-loans during the **whole credit process after securitization**:



a) Security design and retention (theoretical)

- Pooling, tranching and retention are important features to reduce asymmetric information (*Subrahmanyam, 1991 RFS; Gorton/Pennachi, 1993 JoB; DeMarzo, 2005 RFS; Hartman-Glaser et al., 2012 JFE; Chemla/Hennessy 2014 JF*)
- Retention amount as a signal for asset quality, but compulsory flat-rate retention has information destruction effect (*Guo/Wu, 2014 JBF; Hartman-Glaser, 2017 JFE; Vanasco, 2017 JF*)
- Retention as substitute to ratings and reputation (*Hartman-Glaser, 2017 JFE; Daley et al. forthcoming JF*)

b) Security design and retention (empirical)

- Complex deals default more often (*Ghent et al., 2019 RES*)
- If originator is also sponsor or servicer of the deal: improved screening and lower losses; could be due to retention (*Demiroglu/James, 2012 RFS*)
- Retention leads to lower defaults and spreads of loans and tranches (*Begley/Purnanandam, 2017 RFS; Agarwal et al., 2018 WP; Ashcraft et al., 2019 JFE*)

Contribution 1: Retention and loan performance

- **Retention improves loan performance**
 - Loss volume: 112€ lower per loan and year
- **Decomposition of Losses (= Default * EAD * LGD)**
 - Default rate: 1.5 times lower
 - EAD: 16,000 € lower
 - LGD: 11 pp lower

a) Before loan origination (between lender and originator)

- Theoretically: originators lack screening incentives if they are not exposed to credit risk (*Pennacchi, 1988 JF; Gorton/Pennacchi, 1995 JME; Holmstrom/Tirole, 1997 QJE; Petersen/Rajan 1994 JF*)
- Empirically: originators screen less if they have access to the securitization market (*Keys et al., 2010 QJE; Purnanandam, 2011 JFE*)
- Securitized pools are not a random sample of balance sheet loans, e.g. different loan size, credit risk, and prepayment risk (*Keys et al., 2010 QJE; Titman/Tsyplakov, 2010 RFS; Purnanadam, 2011 JFE; Agarwal et al., 2012 JFE; Ghent/Valkanov, 2016 MS; Kara et al., 2018 EFM*)

b) After loan securitization (between originator and investor)

- Less monitoring for securitized loans than for balance sheet loans (*Wang/Xia, 2014 JFE; Kara et al. 2018 EFM*)
- Modifications are less likely, foreclosure is more likely for securitized loans (*Maturana, 2017 RFS*)
- Renegotiations are more successful and re-defaults are less likely for balance sheet loans (*Piskorski et al., 2010 JFE; Agarwal et al., 2011 JFE; Zhang, 2013 JFI; Ghent/Valkanov, 2016 MS; Kruger, 2018 JFE*)

Contribution 2: Retention and bank behavior

- **Retention and monitoring**

- Retention improves **monitoring** effort
(3 times higher probability of rating and valuation changes)
- Retention improves **rating quality**
(8 pp better default prediction)

- **Retention and delinquencies & defaults**

- Retention **prevents NPL**
(58% lower delinquency probability)
- Retention improves the **handling of NPL**
(57 days less in arrears; 1,650€ lower delinquency amount)
- Retention improves **restructuring and modification**
(40% higher probability of NPL-recovery and default-recovery)

- **Retention and securitization decision**

- No evidence for **adverse selection**

Content

1. Introduction
2. Data
3. Empirical strategy
4. Results
5. Causality: IV & PSM
6. Conclusion

- **European RMBS deals issued between 2009–2017**
- **Quarterly loan level data** from EDW (ECB loan level initiative)
- **Retention information hand-collected** from investor prospectuses

- **Exclusion of loans**
 - without unique identifier in a deal
 - with negative time to maturity
 - with missings in control variables

- **Final sample:**
 - 24.9 million loan-quarter observations
 - 2.5 million loans
 - 156 deals

2 Data

Descriptives: retention

Panel A.1: Number of deals issued per year										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
No-Retention-Deals	26	15	1	1	1	1	0	0	0	45
Retention-Deals	0	5	23	20	20	18	8	14	3	111
Total	26	16	24	21	10	19	8	14	3	156

Panel A.2: Observations of deals outstanding							
	2012	2013	2014	2015	2016	2017	Total
No-Retention-Deals	15	43	43	39	28	24	192
Retention-Deals	22	68	83	90	100	90	453
Total	37	111	126	129	128	114	645

Panel B.1: Number of loans per year of deal issuance										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
No-Retention-Deals	222,215	334,205	25,885	26,559	9,140	8,673	0	0	0	636,677
Retention-Deals	0	25,477	356,067	462,667	219,290	266,133	186,820	264,019	39,013	1,819,486
Total	222,215	369,682	381,952	489,226	228,430	274,806	186,820	264,019	39,013	2,456,163

Panel B.2: Observations of loans outstanding							
	2012	2013	2014	2015	2016	2017	Total
No-Retention-Loans	161,924	1,823,559	1,870,406	1,576,689	1,199,716	491,459	7,123,753
Retention-Loans	222,727	3,108,006	3,629,352	4,358,137	4,347,760	2,146,168	17,812,150
Total	384,651	4,931,565	5,499,758	5,934,826	5,547,476	2,637,627	24,935,903

2 Data

Descriptives: dependent & control variables

Variables

	N	Mean	SD	Min	q50	Max		
Dependent variables	Rating Change (0/1)	6,532,858	0.1	0.3	0	1		
	Valuation Change (0/1)	22,652,021	0.4	0.5	0	1		
	Rating Quality (%)	407	80.93	8.09	60.32	81.35	98.21	
	ΔRating Quality (%-p)	407	4.57	7.45	-8.75	2.08	29.18	
	NPL (0/1)	24,935,903	0.000	0.2	0	0	1	
	Time to NPL (days)	36,828	446.9	542.5	1.0	1.0	1,188	
	Time in Arrears (days)	605,904	98.8	91.4	30	60	270	
	Delinquency Amount (€)	608,969	2,451.7	25,080	0	653.3	5,177,620	
	NPL Recovery (0/1)	492,679	0.3	0.5	0	0	1	
	Default Recovery (0/1)	119,223	0.0	0.2	0	0	1	
	Time to Securitize (month)	14,321,360	37.1	19.6	0.9	33.5	117	
	Loss (€)	24,826,395	49.2	3,128.7	0	0	616,470	
	Default (0/1)	24,908,897	0.001	0.1	0	0	1	
	Exposure at Default (€)	33,061	150,055	557,303	0	102,000	11,666,525	
Recovery Rate (%)	10,054	88.5	31.2	0.0	100	100		
Control variables	Mean	SD	Min	p25	p50	p75	Max	
	Interest Rate (%)	3.3	1.7	0	1.5	3.7	4.8	7
	Loan Balance (€)	102,023	74,505.6	0	50,000	89,500	134,456	479,006
	Orig. Loan Vol. (€)	120,449	81,622.7	3,500	67,000	104,000	153,000	535,000
	Loan to Value (%)	72.8	33.0	1.7	48.9	73.6	97.3	143
	Time to Maturity (month)	253.0	112.0	9.0	195.0	258.0	306.0	990
	N	2,456,163						
NxT	24,935,903							

3 Empirical strategy

Theory suggests

Equipping deals with retention should harmonize the interests of originators and investors.

- **Originators' behavior should be improved by retention**
 - Higher screening effort
 - Higher monitoring effort
 - Higher effort in workout process
- **Losses should be reduced by retention**

Our analyses

Do banks treat loans differently, which are similar in as many characteristics as possible and only differ in being assigned to a **retention- vs. no-retention-deal?**

3 Empirical strategy

- **Sample restriction:** only deals of originators which issued retention-deals and no-retention-deals
- **Loan characteristics** as control variables
- **Originator-time fixed effects** for unobservable heterogeneity of originators
- **Standard errors** clustered on deal level

$$Y_{i,t} = \beta_0 + \beta_1 \cdot Retention_d + \delta \cdot Controls_{i,t} + \psi_{t \times o} + \psi_y + \varepsilon_{i,t}$$

- Loan i at time t of originator o in deal d
- $Y_{i,t}$: Proxy variables for bank behavior/effort
- $Retention_d$: Retention- vs. no-retention-deal (indicator variable)
- $Controls$ (loan-level): Loan balance, time to maturity, interest rate, loan to value
- $\psi_{t \times o}$: Originator-time fixed effects
- ψ_y : Year of loan origination fixed effects

Endogeneity

Possible endogeneity problem:

Assigning a loan to a retention- or a no retention-deal may not be exogenous

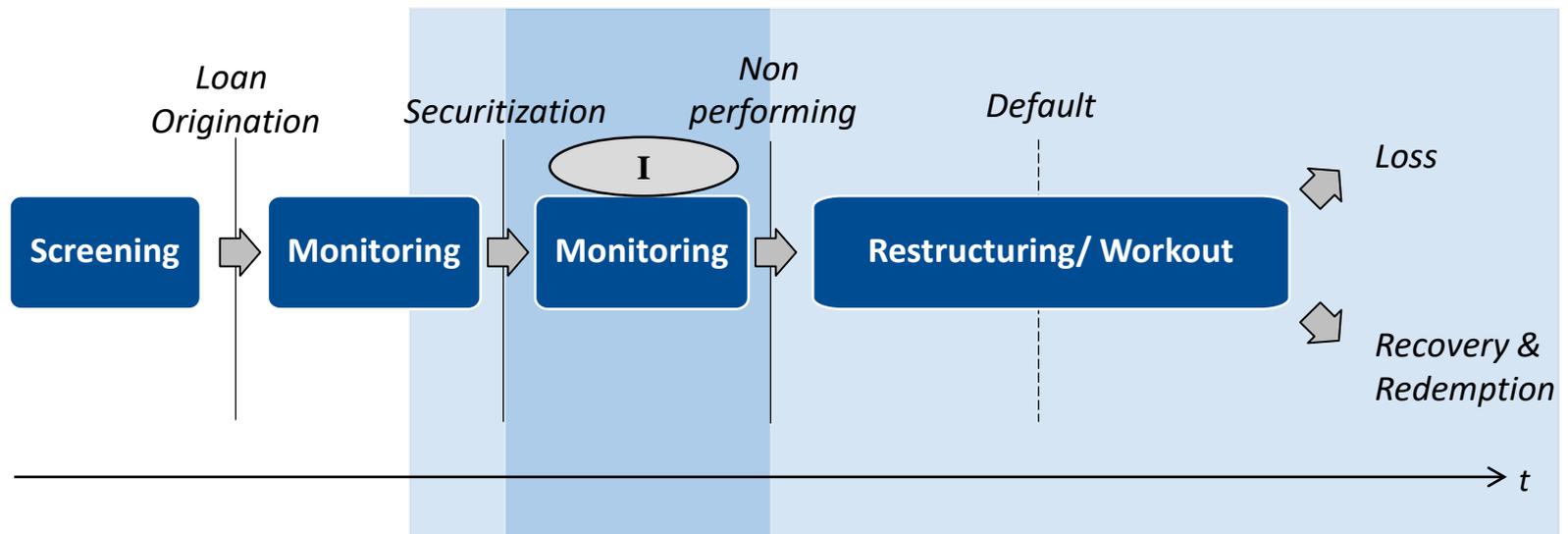
- **We find no significant differences** between retention-loans vs. no-retention-loans **at securitization**
- **Propensity score matching** confirms our results
- **Instrumental variable regressions** confirm our results

4 Results

I. Moral hazard – Monitoring after Securitization

How are the losses reduced in the presence of retention?

Do banks treat loans differently **after securitization**?



I. Monitoring effort

Problem: **Monitoring effort not directly observable**

But: **Monitoring effort results in confirmation or revision of existing evaluation**

- Higher monitoring effort should lead to:
 - Higher frequency of **rating changes**
 - Higher frequency of **valuation changes**
 - Higher quality of **default prediction**

- **Used as proxy variables for monitoring effort**

4 Results

I. Monitoring – Rating and Valuation Changes

[Full Table](#)

	(1) Rating Change	(2) Rating Change	(3) Valuation Change	(4) Valuation Change
Retention	1.302*** (3.484)	1.330*** (3.653)	1.031* (2.418)	1.165* (2.387)
Constant	-9.560*** (-5.439)	7.956*** (9.783)	4.210*** (5.489)	1.275 (1.113)
Observations	6,321,830	5,736,502	22,629,943	21,192,607
Adj. Pseudo R^2	0.391	0.451	0.622	0.650
Controls	Yes	Yes	Yes	Yes
Loan Origination Year FE	Yes	Yes	Yes	Yes
Originator FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Originator x Time FE	No	Yes	No	Yes
Clustered SE	Deal	Deal	Deal	Deal

Standard errors are clustered on deal level. t statistics are presented in parentheses. The signs denote as follows: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Retention leads to ...

- ... **more frequent rating changes** (3 times higher)
- ... **more frequent adjustments of collateral values** (3 times higher)
- Additional findings: Rating changes indeed improve default prediction

I. Monitoring – Rating Quality (1/2)

Two step regression:

1. Evaluate rating quality for each deal:

- How much does the actual rating increase the performance of a naïve rating system?

$$\Delta RatingQuality_{d,t} = RatingQuality_{d,t} - RatingQuality_{d,t,naïve}$$

- **Creation of a naïve rating system** (consisting of loan balance, loan to value, and time to maturity): $P(Default_{i,t+12} = 1 | X_{i,t}) = \beta_0 + \gamma' \cdot Controls_{i,t} + \psi_t$

- **Information surplus due to actual rating:**

$$P(Default_{i,t+12} = 1 | X_{i,t}) = \beta_0 + \beta' \cdot CreditRating_{i,t} + \gamma' \cdot Controls_{i,t} + \psi_t$$

- **For each deal:** The **area under the ROC curve** $AUC_{d,t}$ and the coefficient of determination $R^2_{pseudo,d,t}$ as measures of rating quality

2. Relate rating quality to retention:

$$\Delta RatingQuality_{d,t} = \gamma_0 + \gamma_1 \cdot Retention_d + \psi_{t \times o} + \varepsilon_d$$

4 Results

I. Monitoring – Rating Quality (2/2)

	(1)	(2)	(3)	(4)
	Rating Quality	Rating Quality	Δ Rating Quality	Δ Rating Quality
Retention	0.061*** (10.332)	0.053*** (13.435)	0.084*** (12.130)	0.086*** (22.066)
Constant	0.753*** (128.374)	0.667*** (22.943)	0.045*** (6.467)	-0.092*** (-4.737)
Observations	407	407	407	407
Adj. R ²	0.622	0.606	0.661	0.552
Originator FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Originator x Time FE	No	Yes	No	Yes
1st Step Controls	Yes	Yes	Yes	Yes
Clustered SE	Deal	Deal	Deal	Deal

Standard errors are clustered on deal level. *t* statistics are presented in parentheses. The signs denote as follows: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

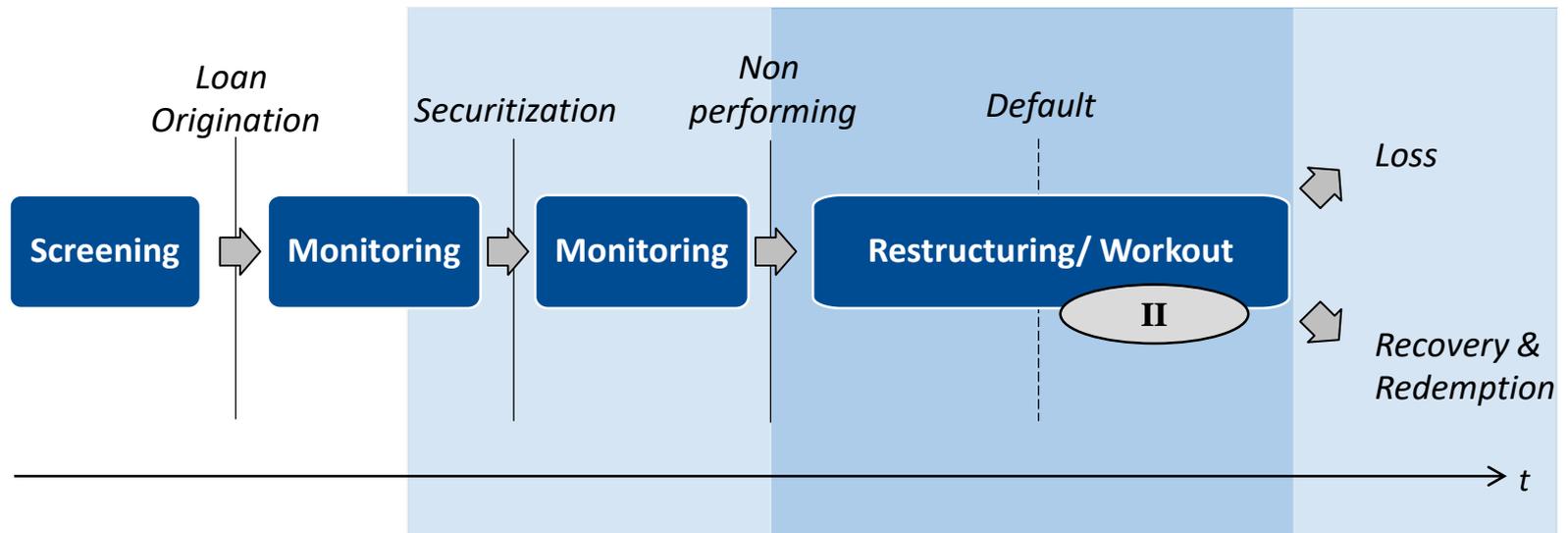
➤ Average rating system has an AUC of 80.9%
(4.6 pp better than the naïve rating system).

➤ **Rating quality** for retention deals increases by about 8 pp.

I ➤ **Main result: Retention improves monitoring effort.**

II. Moral hazard – Workout process

Do banks treat loans differently **during the workout process?**



4 Results

II. Workout process

o,t FE

	NPL	Time to NPL	Time in Arrears	Delinquency Amount	NPL Recovery	Default Recovery
Retention	-0.537*	-5.653	-56.824***	-1,650.9*	0.338***	0.338+
	(-2.234)	(-0.369)	(-3.683)	(-2.039)	(5.502)	(1.827)
Constant	-8.957***	-1120.97***	10.329	6,398.691*	-0.931	-1.350
	(-11.965)	(-7.512)	(0.227)	(2.441)	(-0.723)	(-1.364)
Observations	24,903,628	36,828	599,982	489,149	491,887	64,868
Adj. R ² /Pseudo R ²	0.080	0.726	0.122	0.130	0.046	0.110
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Loan Origination Yr	Yes	Yes	Yes	Yes	Yes	Yes
Originator FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Originator x Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Clustered SE	Deal	Deal	Deal	Deal	Deal	Deal

Standard errors are clustered on deal level. *t* statistics are presented in parentheses. The signs denote as follows: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Retention ...

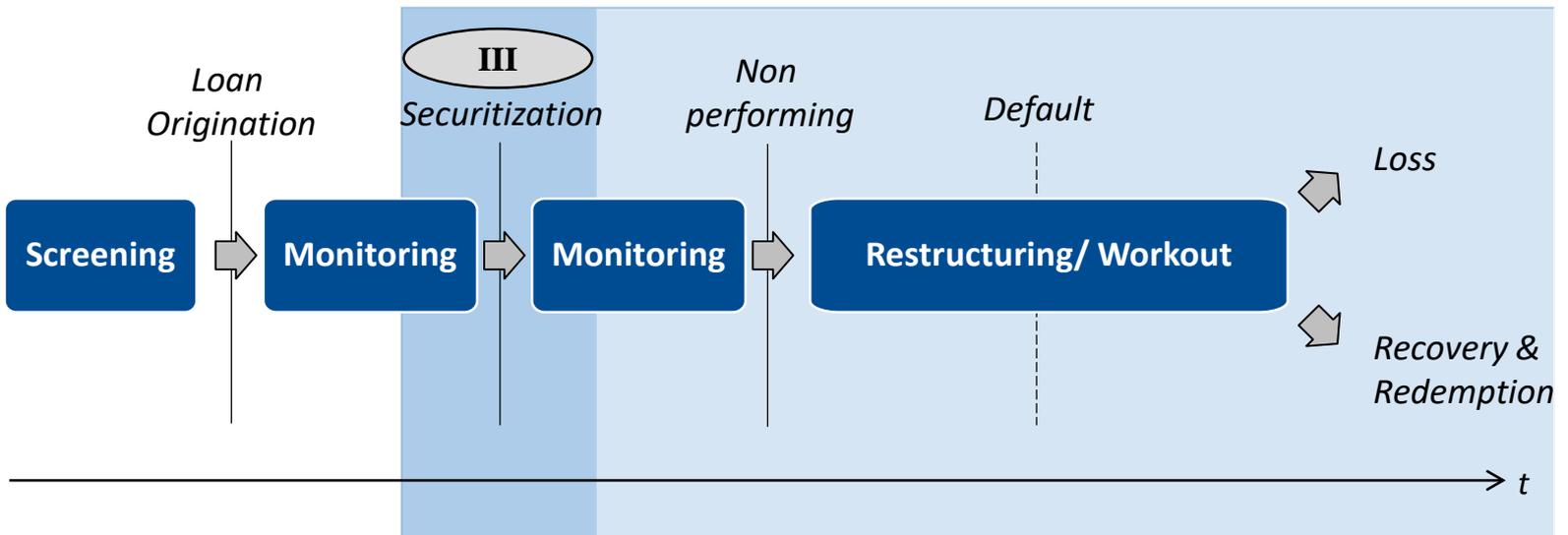
- ... reduces **probability of becoming non-performing (NPL)** by 58%.
- ... decreases the **time in arrears** (57 days) and the **delinquency amount** (1650 €).
- ... increases **probability of recovering from NPL or Default** by 40%.

II

- **Main result: Retention improves treatment of non-performing loans.**

III. Adverse selection at loan securitization

Do loans differ already **at securitization**?

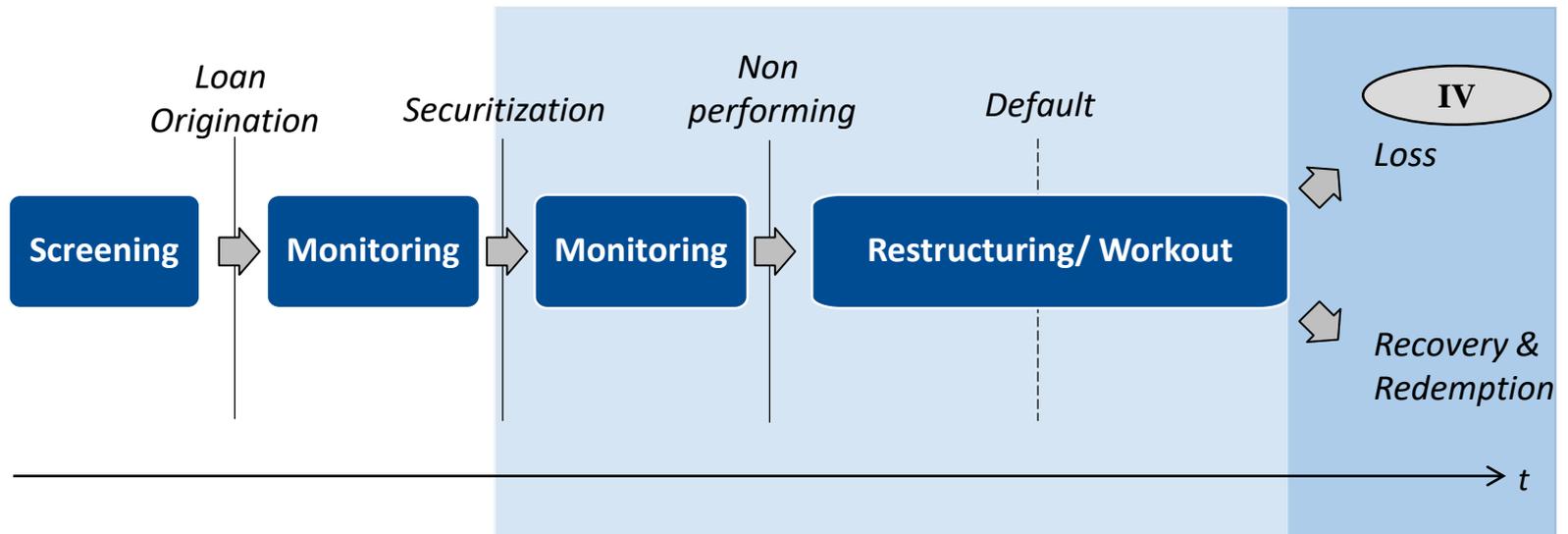


- We find no significant differences regarding Time to Securitize, Interest Rate, Time to Maturity, Loan to Value, and Loan Balance.
- **No evidence for adverse selection** [Tables](#)

IV. Decomposition of losses

Does higher monitoring effort for retention-loans lead to **reduced losses**?

Due to less defaults / lower EADs / lower LGDs?



4 Results

IV. Decomposition of losses

[Full Table](#)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Loss	Loss	Default	Default	EAD	EAD	RR	RR
Retention	-29.524*	-27.989*	-0.433*	-0.411*	-12,391.7	-16,560.2*	11.559+	10.949
	(-2.196)	(-2.122)	(-2.234)	(-2.113)	(-0.997)	(-2.291)	(1.711)	(1.651)
Constant	-333.690***	-347.818***	-13.277***	-10.835***	152,764.7	-155,345.7**	92.96***	99.44***
	(-3.528)	(-3.968)	(-12.836)	(-10.601)	(0.819)	(-3.357)	(10.442)	(16.457)
Observations	24,801,006	24,801,006	15,552,589	14,761,628	33,058	33,058	8,365	8,365
Adj.R ² /Adj. Pseudo R ²	0.001	0.002	0.082	0.096	0.885	0.964	0.783	0.793
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan Origination Yr	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Originator FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Originator x Time FE	No	Yes	No	Yes	No	Yes	No	Yes
Clustered SE	Deal	Deal	Deal	Deal	Deal	Deal	Deal	Deal

Standard errors are clustered on deal level. *t* statistics are presented in parentheses. The signs denote as follows: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Retention leads to...

- ... lower **Losses**: 112€ per loan and year
- ... lower **Default rates**: 1.5 times
- ... lower **Exposure at Default**: 16,000 €
- ... higher **Recovery Rate**: 11 pp

III

➤ **Main result: Retention improves all loss components.**

Two possible mechanisms of retention:

- Assignment to no-retention-deal after credit risk assessment might be more likely for loans that are expected to perform worse.
→ **Retention as indication of future poor performance but not its cause**
- Originators of a no-retention-deal has weaker screening and monitoring incentives resulting in poorer performance.
→ **Retention as cause of poor performance**

Instrument: Access to no-retention-deals

to differentiate between these two explanations (see Ashcraft et al. 2019 JFE)

- **The greater the originator's percentage of no-retention-deals, the better the expected monitoring of loans that are instead assigned to a retention-deal.**
 - Moving average of the **percentage of no-retention-deals** by the same originator,
 - issued within a window surrounding **one year before and after the issuance of deal d**,
 - including all deals **other than d**.
- First stage F-tests suggest that the instrument is strong.
- Second stage results are **in line with our previous findings**.

5 Causality

II. Propensity score matching

Nearest neighbor matching with replacement using interest rate, loan balance, LTV, time to maturity, loan origination year, originator and time

Variable	Retention	No Retention	Difference	<i>t</i> -stat
Rating Change	0.1211	0.0642	0.0569	27.54
Valuation Change	0.4816	0.4585	0.0239	12.52
NPL	0.0230	0.0383	-0.0153	-63.72
Time to NPL	5.089	80.999	-75.91	-6.43
Time in Arrears	137.5	176.9	-39.4	-10.54
Delinquency Amount	2,014	3,484	-1,470	-5.00
Days in Arrears	3.4954	8.3091	4.8137	-31.54
NPL Recovery	0.3160	0.2352	0.0808	27.3
Default Recovery	0.0307	0.0158	0.0148	6.03
Loss	15.41	55.57	-40.16	-9.42
Default	0.091	0.123	-0.316	-5.86
EAD	150,753	194,280	-43,526	-0.76
RR	91.97	58.73	33.24	3.87

➤ **Average treatment effects on the treated (ATT) resulting from a PSM in line with all previous loan level analyses**

Summary of results

Variables

I	<i>Moral Hazard – Monitoring after Securitization</i>	Rating Change	✓
		Valuation Change	✓
		Rating Quality	✓
		Δ Rating Quality	✓
II	<i>Moral Hazard – Restructuring and Workout of Non-Performing Loans</i>	NPL	✓
		Time to NPL	✗
		Time in Arrears	✓
		Delinquency Amount	✓
		NPL Recovery	✓
		Default Recovery	✓
III	<i>Adverse Selection – at Loan Securitization</i>	Time to Securitize	✗
		Interest Rate	✗
		Time to Maturity	✗
		Loan to Value	✗
		Loan Balance	✗
IV	Losses and Decomposition of Losses	Loss	✓
		Default	✓
		Exposure at Default	✓
		Recovery Rate	✓

Conclusion

- Theoretical arguments regarding difference between balance sheet loans and securitized loans transferred to **retention- vs. no-retention-loans**.
- **Strong evidence for moral hazard**: Retention improves bank behavior after securitization
 - **Higher monitoring effort** (rating quality, frequency of rating & valuation changes)
 - **Improved NPL prevention** (delinquency probability, time to NPL)
 - **Increased restructuring and modification effort** (delinquency volume & duration, recovery probability)
- **No evidence for adverse selection**
- **Retention reduces losses** – Decomposition: lower default rates, EADs and LGDs
- **Comprehensive image on benefits of retention** – providing insights on the way ABS should be designed to ensure trust and proper actions.

Open questions

What remains unclear:

Is the level of effort for retention-loans comparable to balance-sheet-loans?

How does

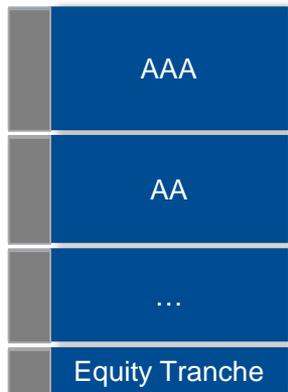
- a given originator
- at a given point in time
- treat three loans which are equal in all characteristics but:
 - one is kept on the balance sheet,
 - one is securitized in a retention-deal,
 - and one is securitized in a no-retention-deal?

Backup

Five retention types (Art. 405 CRR)

Mandatory retention of at least 5% of the deal volume

Vertical Slice



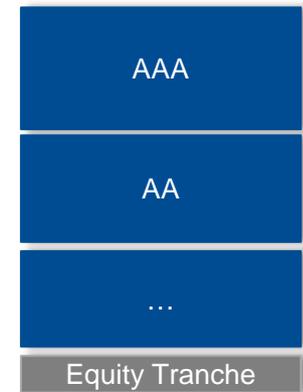
Sellers Share*



Random Selection



Equity Retention



Variables

<i>Default</i>	Indicator variable equal to one if a loan will default in $t+1$
<i>DefaultRecovery</i>	Indicator variable equal to one if a loan is in default in t and will become performing or will be redeemed in $t+1$
<i>DelinquencyAmount</i>	Volume in arrears, given a loan is delinquent (in €)
<i>ExposureAtDefault</i>	Outstanding balance in t if a loan will default in $t+1$ (in €)
<i>InterestRate</i>	Current interest rate (in %)
<i>InternalRating</i>	Internal rating of a loan, measured by a set of indicator variables for each rating class of a deal's rating system
<i>LoanBalance</i>	Current loan balance (in €)
<i>LoanToValue</i>	Current ratio of loan balance and collateral value (in %)
<i>Loss</i>	Default volume minus cumulative recoveries (in €)
<i>NPL</i>	Indicator variable equal to one if a loan is delinquent
<i>NPLRecovery</i>	Indicator variable equal to one if a loan is delinquent in t and will become performing or will be redeemed in $t+1$
<i>OriginalLoanVolume</i>	Loan volume at loan origination
<i>RecoveryRate</i>	Cumulative recoveries divided by default volume
<i>RatingChange</i>	Indicator variable equal to one if a loan's rating changes in the time between t and $t+1$
<i>RatingQuality</i>	Deal's rating system's capability to predict defaults within the next 12 months (pseudo R^2 , measured in %)
<i>ΔRatingQuality</i>	Surplus of a deal's rating system's capability to predict defaults within the next 12 months over a naïve rating system's capability (measured in %-points)
<i>Retention</i>	Indicator variable equal to one for retention loans (loans that are securitized in a deal with retention) and retention deals
<i>TimeInArrears</i>	Number of days a loan is delinquent
<i>TimeToMaturity</i>	Number of months until date of loan maturity
<i>TimeToNPL</i>	Number of days between loan securitization and date of loan delinquency
<i>TimeToSecuritize</i>	Number of months between loan origination and loan securitization
<i>ValuationChange</i>	Indicator variable equal to one if a loan's collateral value changes in the time between t and $t+1$

Loan Characteristics – multivariate

$$P(\text{Retention}_i = 1 | X_i) = \beta_0 + \beta_1 \cdot \text{TimeToSecuritize}_i + \beta_2 \cdot \text{InterestRate}_i \\ + \beta_3 \cdot \text{LoanBalance}_i + \beta_4 \cdot \text{LoanToValue}_i + \beta_5 \cdot \text{TimeToMaturity}_i$$

	(1) Retention	(2) Retention
Time to Securitize	-0.007 (-0.338)	-0.010 (-0.350)
Interest Rate	-0.006 (-0.053)	-0.045 (-0.415)
Loan Balance	-0.000 (-1.288)	0.000 (0.196)
Loan to Value	0.005 (1.355)	0.001 (0.141)
Time to Maturity	0.001 (1.272)	-0.000 (-0.257)
Constant	-1.439 (-0.765)	1.327 (0.409)
Observations	1,439,620	928,464
Adj. Pseudo R^2	0.329	0.370
Loan Origination Yr FE	Yes	Yes
Originator FE	Yes	Yes
Time FE	Yes	Yes
Originator x Time FE	No	Yes
Clustered SE	Deal	Deal

Standard errors are clustered on deal level. t statistics are presented in parentheses. The signs denote as follows: *** $p < 0.001$.

III



Main result: No evidence for adverse selection.

4 Results

I. Monitoring – Rating and Valuation Changes

[Return](#)

Rating and collateral valuation changes might be due to a new assessment of credit risk within monitoring.

	(1) Rating Change	(2) Rating Change	(3) Valuation Change	(4) Valuation Change
Retention	1.302*** (3.484)	1.330*** (3.653)	1.031* (2.418)	1.165* (2.387)
Interest Rate	-0.001 (-0.031)	-0.091** (-2.654)	0.095* (2.335)	0.124** (3.185)
Log Loan Balance	0.470 (1.624)	-0.053 (-1.569)	-0.209** (-2.815)	-0.311*** (-5.134)
Loan to Value	-0.005 (-1.011)	0.004*** (3.973)	0.014*** (3.928)	0.014*** (4.087)
Time to Maturity	-0.002* (-2.032)	-0.000 (-0.869)	0.001** (2.638)	0.002*** (3.533)
Constant	-9.560*** (-5.439)	7.956*** (9.783)	4.210*** (5.489)	1.275 (1.113)
Observations	6,321,830	5,736,502	22,629,943	21,192,607
Adj. Pseudo R^2	0.391	0.451	0.622	0.650
<i>Fixed Effects</i>				
Loan Origination Year	Yes	Yes	Yes	Yes
Originator	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Originator x Year	No	Yes	No	Yes
Clustered SE	Deal	Deal	Deal	Deal

Standard errors are clustered on deal level. t statistics are presented in parentheses. The signs denote as follows: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4 Results

II. Workout process: Originator, time FE

[Return](#)

	(1) NPL	(2) Time to NPL	(3) Time in Arrears	(4) Delinquency Amount	(5) NPL Recovery	(6) Default Recovery
Retention	-0.540*	591.819***	-58.258***	-1,626.1*	0.316***	0.373*
	(-2.307)	(9.038)	(-3.925)	(-2.027)	(5.194)	(2.330)
Constant	-8.341***	-1319.351**	-13.502	11,668.037**	-1.595	-2.094
	(-10.211)	(-3.175)	(-0.249)	(3.140)	(-1.280)	(-1.360)
Observations	24,903,628	36,828	599,982	489,149	492,284	65,236
Adj. R^2	0.076	0.698	0.109	0.079	0.040	0.098
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Loan Origination Yr	Yes	Yes	Yes	Yes	Yes	Yes
Originator FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Originator x Time FE	No	No	No	No	No	No
Clustered SE	Deal	Deal	Deal	Deal	Deal	Deal

Standard errors are clustered on deal level. t statistics are presented in parentheses. The signs denote as follows: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4 Results

IV. Decomposition of losses

[Return](#)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Loss	Loss	Default	Default	EAD	EAD	RR	RR
Retention	-29.524* (-2.196)	-27.989* (-2.122)	-0.433* (-2.234)	-0.411* (-2.113)	-12,391.7 (-0.997)	-16,560.2* (-2.291)	11.559+ (1.711)	10.949 (1.651)
Interest Rate	2.997* (2.081)	3.436* (2.204)	0.241*** (7.096)	0.230*** (6.891)	734.98 (0.399)	-5,429.31*** (-7.121)	0.268 (0.891)	0.229 (0.899)
Log Loan Balance	23.608** (3.135)	24.278** (3.129)	0.092+ (1.751)	0.085 (1.539)			-0.972 (-1.621)	-1.096 (-1.520)
Loan to Value	0.202* (2.570)	0.188* (2.401)	0.025*** (8.126)	0.026*** (7.052)	290.90*** (3.486)	403.31*** (4.215)	0.004 (0.396)	0.001 (0.051)
Time to Maturity	0.001 (0.055)	0.001 (0.092)	-0.001 (-1.039)	-0.001 (-1.376)	118.08*** (4.161)	135.58*** (5.649)	0.005 (0.854)	0.003 (0.702)
Original Loan Volume					0.501*** (21.335)	0.160*** (3.962)		
Constant	-333.690*** (-3.528)	-347.818*** (-3.968)	-13.277*** (-12.836)	-10.835*** (-10.601)	152,764.7 (0.819)	-155,345.7** (-3.357)	92.958*** (10.442)	99.443*** (16.457)
Observations	24,801,006	24,801,006	15,552,589	14,761,628	33058	33058	8,365	8,365
Adj. R^2 /Adj. Pseudo R^2	0.001	0.002	0.082	0.096	0.885	0.964	0.783	0.793
<i>Fixed Effects</i>								
Loan Origination Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Originator	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Originator x Year	No	Yes	No	Yes	No	Yes	No	Yes
Clustered SE	Deal	Deal	Deal	Deal	Deal	Deal	Deal	Deal

Standard errors are clustered on deal level. t statistics are presented in parentheses. The signs denote as follows: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5 Causality

Instrumental variable approach (1/3)

[Return](#)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Rating Change	Rating Change	Valuation Change	Valuation Change	NPL	NPL	Time to NPL	Time to NPL	Time in Arrears	Time in Arrears
Fitted Retention	0.025 (1.044)	0.050 (1.438)	0.070 (1.578)	0.078 ⁺ (1.843)	-0.015 ^{**} (-2.977)	-0.014 ^{**} (-2.887)	-868.853 (-0.814)	-5,065.621 ⁺ (-1.714)	-84.84 ^{***} (-3.442)	-79.57 ^{**} (-2.982)
Constant	-0.157 (-1.432)	-0.014 (-0.505)	1.290 ^{***} (12.073)	0.849 ^{***} (10.670)	-0.051 ^{***} (-3.592)	-0.061 ^{***} (-5.187)	1460.124 (1.239)	5224.732 (1.611)	-145.60 [*] (-2.242)	-114.95 ⁺ (-1.872)
Observations	6,526,992	6,526,992	22,630,706	22,630,706	24,905,049	24,905,049	36,828	36,828	599,982	599,982
Adjusted R^2	0.247	0.328	0.623	0.698	0.019	0.020	0.469	.	0.109	0.122
Loan Level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Fixed Effects</i>										
Loan Origination Yr	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Originator	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Originator x Year	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Clustered SE	Deal	Deal	Deal	Deal	Deal	Deal	Deal	Deal	Deal	Deal

5 Causality

Instrumental variable approach (2/3)

[Return](#)

	(11) Delinquency Amount	(12) Delinquency Amount	(13) NPL Recovery	(14) NPL Recovery	(15) Default Recovery	(16) Default Recovery
Fitted Retention	-3,000.854* (-2.516)	-3,012.623* (-2.369)	0.058*** (6.147)	0.061*** (6.145)	0.011** (2.787)	0.009** (2.814)
Constant	6772.700* (2.335)	2308.801 (0.872)	0.288** (3.269)	0.449*** (4.749)	-0.002 (-0.049)	-0.024 (-0.566)
Observations	489149	489149	492,286	492,286	109,489	109,489
Adjusted R^2	0.078	0.130	0.044	0.050	0.063	0.073
Loan Level Controls	Yes	Yes	Yes	Yes	Yes	Yes
<i>Fixed Effects</i>						
Loan Origination Year	Yes	Yes	Yes	Yes	Yes	Yes
Originator	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Originator x Year	No	Yes	No	Yes	No	Yes
Clustered SE	Deal	Deal	Deal	Deal	Deal	Deal

5 Causality

Instrumental variable approach (3/3)

[Return](#)

	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
	Loss	Loss	Default	Default	EAD	EAD	RR	RR
Fitted Retention	-28.095* (-2.017)	-23.675+ (-1.793)	-0.005+ (-1.664)	-0.004 (-1.455)	-9,561.59 (-1.511)	-11,027.26* (-1.978)	1.669 (0.682)	2.284 (0.938)
Constant	-334.317*** (-3.540)	-350.817*** (-3.977)	-0.021*** (-4.696)	-0.020*** (-5.131)	239,435.47 (1.303)	-19,299.77 (-1.639)	104.4*** (11.73)	105.7*** (12.44)
Observations	24,801,006	24,801,006	21,999,440	21,999,440	33,061	33,061	8,365	8,365
Adjusted R ²	0.001	0.002	0.016	0.018	0.885	0.964	0.774	0.786
Loan Level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Fixed Effects</i>								
Loan Origination Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Originator	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Originator x Year	No	Yes	No	Yes	No	Yes	No	Yes
Clustered SE	Deal	Deal	Deal	Deal	Deal	Deal	Deal	Deal