

*Monetary Policy, Lending Standards and Bank Risk-Taking: Evidence from the Swedish Mortgage Market**

Jieying Li and Peter van Santen
Sveriges Riksbank

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*The opinions expressed in this article are the sole responsibility of the authors and should not be interpreted as reflecting the views of Sveriges Riksbank.

Motivation

- ▶ Long period of low interest rates
- ▶ Are banks taking more risk due to low rates?
- ▶ Key literature findings:
 - Jimenez et al, ECTRA (2014): low rates lead to more lending to firms with bad credit histories (by low-capitalized banks)
 - Dell'Ariccia et al, JF (2016): low rates relax credit standards
- ▶ Policy relevant questions: should CB 'lean against the wind'? Are we 'planting seeds for the next credit crisis'?

Contribution

- ▶ We explore how policy rates affect bank risk-taking in mortgage lending
- ▶ Detailed data from Swedish banks
 - Rates increased during 2010-2012 and decreased afterwards
 - Exploit interest-rate induced variation in borrowers' credit limit between banks and over time
 - No need to rely on (endogenous) capital structure of banks
- ▶ We find a shift of the composition of credit supply **towards high-risk** mortgage borrowers, especially for banks having higher credit limits induced by low interest rates

Discretionary Income Calculation

- ▶ By law, the Swedish banks have to assess borrowers' repayment abilities before making a lending decision
- ▶ Banks use similar formula to compute the discretionary income

$$\begin{aligned} \text{DiscretionaryIncome} = & \text{Income} - \text{Taxes} - \text{LivingCosts} \\ & - \text{Amortization} - \text{InterestExpenses} \geq 0 \end{aligned}$$

- ▶ The household-specific credit limit is determined:

$$\text{Debt}^{\text{MAX}} = \frac{\text{DisposableIncome}}{\alpha + r(1 - \tau)}$$

- ▶ Borrowers are informed in the form of a loan pre-approval

Discretionary Income Calculation

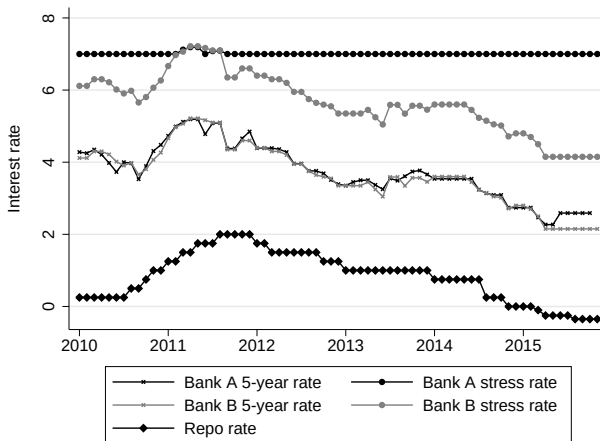
$$\text{DiscretionaryIncome} = \text{DisposableIncome} - \text{Amortization} \\ - \text{InterestExpenses} \geq 0$$

- ▶ Interest expenses: **Stressed rate** × Debt
 - Higher than real mortgage rate

	# banks	Stressed rate setting
Fixed-rate banks	4	Constant rate or impose a floor of 7-8%
Market-rate banks	4	Listed 5-year mortgage rate + markup (2-3%)

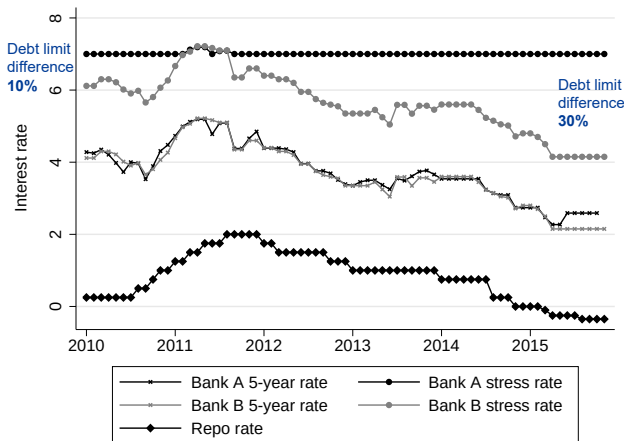
Stressed rates

- Stressed rates reflect the policy rate and differentiate credit limits across banks



Stressed rates

- Stressed rates reflect the policy rate and differentiate credit limits across banks



Hypotheses to be tested

- ▶ Do borrowers take larger loans at banks with lower stressed rates?
- ▶ Do banks with lower stressed rates grant more credit to risky borrowers?

Data and Sample

- ▶ Monthly data on all new mortgage loans originated by the 8 largest banks in Sweden July 2010-July 2015
- ▶ Stressed rates 2010-2016 for the same banks from the loan officer surveys administered by the Swedish FSA

Borrower risk indicators

- ▶ Sort borrowers based on their pre-sample PD as estimated by the credit bureau
- ▶ Risky borrowers are those with $PD > 10\%$
- ▶ Results robust to other cut-offs or information on arrears and debt restructuring

Bank-level evidence

Stressed rate and the market share in the new-loan market

$$MarketShare_{jt} = \beta StressedRate_{jt} + \phi_j + \theta_t + \epsilon_{jt}$$

	All borrowers	Safe borrowers	Risky borrowers
Stressed rate	-0.00508** (0.00227)	-0.00490** (0.00227)	-0.0142*** (0.00376)
Observations	480	480	480

- In the market of risky borrowers, market-stressed-rate banks gained around 1.42%-point more market share for every percent decrease in their stressed rate

Loan-level evidence: baseline

$$\ln(\text{NewLoanSize}_{ijt}) = \beta_1 \text{RiskyBorrowerDummy}_i * (\text{StressedRate}_{jt} / \text{MarketRateBank}_j) + \beta_2 \text{RiskyBorrowerDummy}_i + \beta_3 X_{it} + \beta_4 \phi_{jt} + \beta_5 \theta_{ct} + \epsilon_{ijt}$$

	Dependent Variable: Ln(New loan size)	
	Stressed rate	Market rate bank
Risky borrower dummy × (column title)	-0.0438** (0.0221)	0.0781* (0.0431)
Risky borrower dummy	0.553*** (0.165)	0.209*** (0.0280)
Ln HH income July 2010 × (column title)	-0.00111 (0.00240)	0.00196 (0.00579)
Ln HH income July 2010	0.0473** (0.0189)	0.0385*** (0.00390)
HH income growth since July 2010	0.0320*** (0.00183)	0.0319*** (0.00182)
Change in credit score since July 2010	0.0801*** (0.00841)	0.0800*** (0.00841)
Other household controls	YES	YES
Bank*Month FE	YES	YES
Parish*Month FE	YES	YES
Observations	1748570	1748570
R ²	0.050	0.049

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Loan-level evidence: direction of policy rate

$$\ln(\text{NewLoanSize}_{ijt}) = \beta_1 \text{RiskyBorrowerDummy}_i * \text{StressedRate}_{jt} \\ + \beta_2 \text{RiskyBorrowerDummy}_i + \beta_3 X_{it} + \beta_4 \phi_{jt} + \beta_5 \theta_{ct} + \epsilon_{ijt}$$

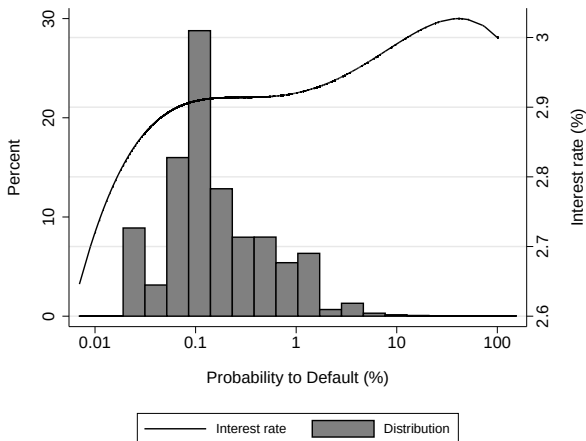
	Dependent Variable: Ln(New loan size)		
	Baseline Full sample	Increasing repo rate 2010:08–2011:12	Decreasing repo rate 2012:01–2015:07
Risky borrower dummy x Stressed rate	-0.0438** (0.0221)	0.0185 (0.0122)	-0.0384** (0.0190)
Risky borrower dummy	0.553*** (0.165)	0.0547 (0.111)	0.523*** (0.137)
Other household controls	YES	YES	YES
Bank*Month FE	YES	YES	YES
Parish*Month FE	YES	YES	YES
Observations	1748570	529503	1219067
R ²	0.050	0.049	0.051

Loan-level evidence: robustness checks

- ▶ Robust to **cut-offs** of credit score in borrower risk definition
- ▶ Alternative borrower risk measures: (i) With debt at Kronofogden (ii) In arrears
- ▶ **Drop obs in 2010** when LTV-cap was implemented
- ▶ The **riskier** the borrower, the **bigger** the gap between the loan size from market-stressed-rate (lower stressed rate) banks relative to that from fixed-stressed-rate (higher stressed rate) banks

"Search for yield"?

- Increasing risks are **priced to some extent** into the lending rates



Conclusion

- ▶ Robust evidence at both aggregate and individual loan level on a shift of the composition of credit supply towards risky borrowers $\Rightarrow$ "search for yield" incentives when interest rates are low
- ▶ Evidence in mortgage lending in Sweden (full liability) can be viewed as a conservative case for broad risk-taking under the low-rate environment
- ▶ Variations in lending outcomes among banks using different stressed-rate setting for credit limit $\Rightarrow$ business models or risk culture? Further research needed

Heterogeneity of risk-taking across banks

- ▶ Capital structure? ⇒ **Similar ex-ante** capital structure and other bank characteristics
- ▶ Stress-rate setup was **predetermined a long time before** the low-rate environment ⇒ Reflect banks' **business models or risk culture?** (i.e. Ellul and Yerramilli, 2013; Fahlenbrach et al., 2012)
 - Risk appetite and sensitivity risk-taking incentives when rates are low?
 - Strength of risk management? (i.e. Stulz, 2008)
 - Incentives of management and employees aligned with risk-taking objectives? (i.e. Saunders et al., 1990; Fahlenbrach and Stulz, 2011; Cheng et al., 2015)

Softer lending standard?

- ▶ High-risk borrowers shopping for credit target market-rate banks and demand a larger loan size from them? $\Rightarrow$ Unlikely
 - No cost for high-risk borrowers to ask for (the same) credit from fixed-rate banks
 - Most households tie up with one bank and haven't switched when applying for new mortgage loans
- ▶ Deviating from the existing standard vs. existing standard is too loose under the current economic conditions

Appendix

- ▶ Monetary policy and bank risk-taking
 - A lower interest rate spurs bank risk-taking (i.e. De Nicolò et al., 2010; Jiménez et al., 2014; Ioannidou et al., 2015; Dell'Ariccia et al., 2016; Heider et al., 2016; Paligorova and Santos, 2016)
 - Transmission mechanism depends on the capital structure (i.e. Dell'Ariccia et al., 2014; Jiménez et al., 2014; Dell'Ariccia et al., 2016)
 - This paper provides evidence on mortgage market and effect through the credit limit determinant
- ▶ Household debts and mortgage lending standard
 - Credit supply view (i.e. Mian and Sufi, 2009; Mian and Sufi, 2011; Dell'Ariccia et al., 2012; Besley et al., 2013; Akin et al., 2014)
 - Demand-side effects (i.e. Bhardwaj and Sengupta, 2009; Foote et al., 2012; Adelino et al., 2016)
 - This paper provides evidence on the link between underwriting standards and policy rates

- ▶ Banks' business models or risk culture and risk management
 - Business model can determine both the risk-taking and the strength of the risk management system (i.e. Ellul and Yerramilli, 2013)
 - Results in this paper may reflect aspects of banks' risk culture, but further study on the mechanism needed

Summary statistics

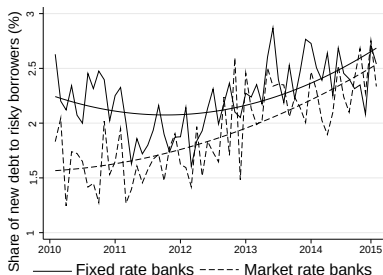
	N	Mean	Median	Standard Deviation
<i>Household-level variables</i>				
New loan size	1,748,570	849,537	482,660	977,819
HH total mortgage debt at the new loan supplier	1,748,570	1,682,955	1,300,000	2,057,684
HH total mortgage debt at the new loan supplier _{t-1}	1,748,570	958,063	592,215	1,855,517
HH total mortgage debt	1,748,570	1,899,792	1,448,000	2,299,717
HH total mortgage debt _{t-1}	1,748,570	1,317,934	958,887	2,043,200
HH total non-mortgage debt	1,748,570	79,092	2,838	338,394
HH total non-mortgage debt _{t-1}	1,748,570	76,800	5,432	313,699
HH total debt	1,748,570	1,978,885	1,500,000	2,396,533
HH total debt _{t-1}	1,748,570	1,394,734	1,020,886	2,100,700
Risky borrower dummy	1,115,593	0.0190	0.000	0.137
With debt at Kronofogden	1,115,593	0.00379	0.000	0.0614
In arrears	1,115,593	0.0226	0.000	0.149
Credit score July 2010	1,115,593	1.063	0.200	4.488
HH income July 2010	1,115,593	557,824	512,200	378,820
HH income growth since July 2010	1,748,570	0.0913	0.0514	1.135
Change in credit score since July 2010	1,748,570	0.0585	1.49e-08	0.997
Apartment	1,748,570	0.300	0.000	0.458
Age	1,748,570	47.718	46.500	12.659
HH size	1,748,570	1.611	2.000	0.490

Summary statistics

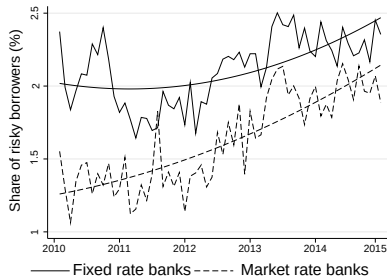
	N	Mean	Median	Standard Deviation
<i>Bank-level variables</i>				
Listed 5-year mortgage rate %	480	3.747	3.640	0.810
Stressed rate %	480	7.248	7.500	0.668
Equity to assets %	8	3.880	3.981	0.722
Loans to deposits %	8	201	208	65
Loan loss ratio %	8	0.640	0.385	0.618
Return on assets %	8	0.254	0.264	0.344
Return on equity %	8	7.499	6.855	8.412

Aggregate-level evidence

Share of new debt to risky borrowers

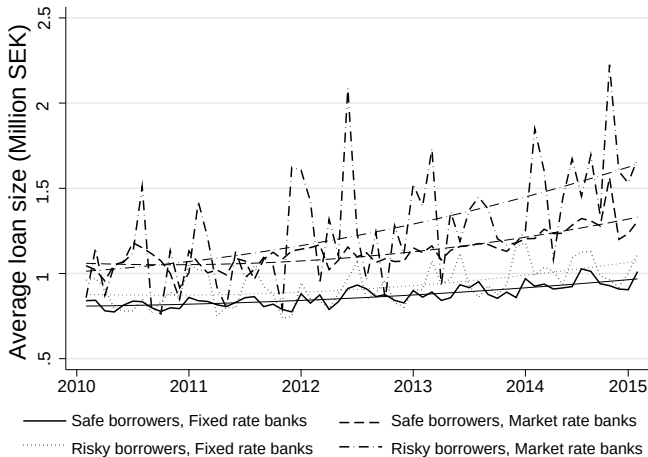


Share of risky borrowers



Aggregate-level evidence

Average loan size



Loan-level evidence: robustness checks

Robustness to **cut-offs** of credit score in borrower risk definition

$$\ln(\text{NewLoanSize}_{ijt}) = \beta_1 \text{RiskyBorrowerDummy}_i * \text{StressedRate}_{jt} \\ + \beta_2 \text{RiskyBorrowerDummy}_i + \beta_3 X_{it} + \beta_4 \phi_{jt} + \beta_5 \theta_{ct} + \epsilon_{ijt}$$

Credit score $\geq X$	Dependent Variable: $\ln(\text{New loan size})$
	$\text{RiskyBorrowerDummy}_i * \text{StressedRate}_{jt}$
5	-0.0317*
6	-0.0322**
7	-0.0392**
8	-0.0426**
9	-0.0443**
10 (baseline)	-0.0438**
11	-0.0433*
12	-0.0444**
13	-0.0430*
14	-0.0445*
15	-0.0429*

Loan-level evidence: robustness checks

Alternative borrower risk measures: (i) With debt at Kronofogden (ii) In arrears

$$\ln(\text{NewLoanSize}_{ijt}) = \beta_1 \text{BorrowerRiskIndicator}_i * \text{StressedRate}_{jt} \\ + \beta_2 \text{BorrowerRiskIndicator}_i + \beta_3 X_{it} + \beta_4 \phi_{jt} + \beta_5 \theta_{ct} + \epsilon_{ijt}$$

	Dependent Variable: Ln(New loan size)		
	Risky borrower dummy (Baseline)	With debt at Kronofogden	In arrears
(column title) × Stressed rate	-0.0438** (0.0221)	-0.0588* (0.0312)	-0.0210* (0.0125)
(column title)	0.553*** (0.165)	0.661*** (0.225)	0.401*** (0.0948)
Other household controls	YES	YES	YES
Bank*Month FE	YES	YES	YES
Parish*Month FE	YES	YES	YES
Observations	1748570	1748570	1748570
R ²	0.050	0.049	0.050

Loan-level evidence: robustness checks

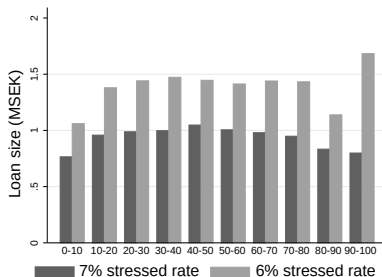
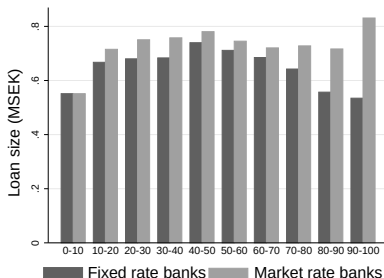
Drop obs in 2010 for consideration of a mortgage cap with a maximum LTV of 85% introduced in Sweden

$$\ln(\text{NewLoanSize}_{ijt}) = \beta_1 \text{RiskyBorrowerDummy}_i * \text{StressedRate}_{jt} \\ + \beta_2 \text{RiskyBorrowerDummy}_i + \beta_3 X_{it} + \beta_4 \phi_{jt} + \beta_5 \theta_{ct} + \epsilon_{ijt}$$

	Dependent Variable: Ln(New loan size)	
	Baseline	Drop 2010 months
Risky borrower dummy x Stressed rate	-0.0438** (0.0221)	-0.0438** (0.0211)
Risky borrower dummy	0.553*** (0.165)	0.560*** (0.157)
Other household controls	YES	YES
Bank*Month FE	YES	YES
Parish*Month FE	YES	YES
Observations	1748570	1570705
R ²	0.050	0.051

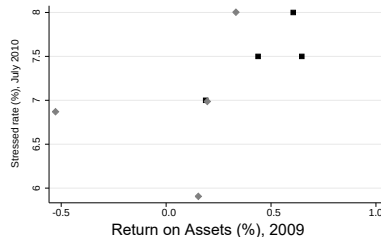
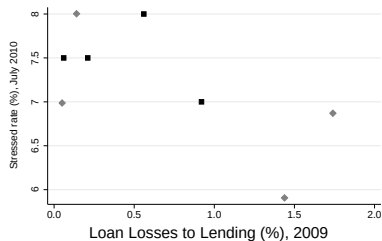
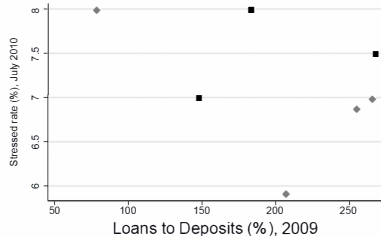
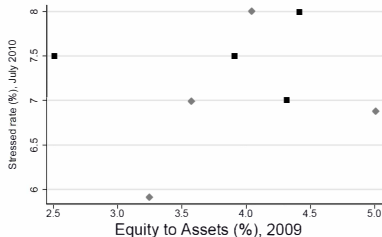
Loan-level evidence: robustness checks

Estimated new loan size using **risk bucket dummies** as borrower risk indicator



Stressed rate and bank characteristics

Does stressed-rate setup reflect ex-ante bank characteristics?



■ Fixed rate banks ♦ Market rate banks

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Stressed rate and bank characteristics

Does stressed-rate setup reflect ex-ante bank characteristics?

$$\text{StressedRate}_{jt} = \beta \text{BankCharacteristics}_{jt-1} + \gamma \phi_j + \delta \theta_t + \epsilon_{jt}$$

	Dependent Variable: Stressed Rate						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Equity to assets	-32.93 (28.82)					-30.44 (28.17)	-26.58 (30.49)
Loans to deposits		-0.0103 (0.0108)				-0.0106 (0.0137)	-0.0113 (0.0136)
Loan losses to lending			0.180 (0.400)			0.406 (0.682)	0.301 (0.768)
ROA				8.471 (23.23)		60.42 (56.86)	
ROE					0.173 (1.099)		2.131 (3.262)
Bank FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Observations	48	48	48	48	48	48	48
R-squared	0.730	0.730	0.728	0.726	0.726	0.742	0.739

References I

- Adelino, Manuel, Antoinette Schoar, and Felipe Severino, 2016, Loan originations and defaults in the mortgage crisis: The role of the middle class, *Review of Financial Studies* 29, 1635–1670.
- Akin, Ozlem, José García Montalvo, Jaume García Villar, José-Luis Peydró, and Josep Maria Raya, 2014, The real estate and credit bubble: Evidence from Spain, *SERIEs* 5, 223–243.
- Besley, Timothy, Neil Meads, and Paolo Surico, 2013, Risk heterogeneity and credit supply: Evidence from the mortgage market, in *NBER Macroeconomics Annual 2012, Volume 27*, 375–419 (University of Chicago Press).
- Bhardwaj, Geetesh, and Rajdeep Sengupta, 2009, Wheres the Smoking Gun? A Study of Underwriting Standards for US Subprime Mortgages, Working paper.
- Cheng, Ing-Haw, Harrison Hong, and Jose A Scheinkman, 2015, Yesterday's heroes: compensation and risk at financial firms, *The Journal of Finance* 70, 839–879.
- De Nicolò, Gianni, Giovanni Dell'Ariccia, Luc Laeven, and Fabian Valencia, 2010, Monetary policy and bank risk taking, Working paper.
- Dell'Ariccia, Giovanni, Deniz Igan, and Luc Laeven, 2012, Credit booms and lending standards: Evidence from the subprime mortgage market, *Journal of Money, Credit and Banking* 44, 367–384.
- Dell'Ariccia, Giovanni, Luc Laeven, and Robert Marquez, 2014, Real interest rates, leverage, and bank risk-taking, *Journal of Economic Theory* 149, 65–99.
- Dell'Ariccia, Giovanni, Luc Laeven, and Gustavo Suarez, 2016, Bank leverage and monetary policy's risk-taking channel: Evidence from the United States, *The Journal of Finance*, forthcoming.
- Ellul, Andrew, and Vijay Yerramilli, 2013, Stronger risk controls, lower risk: Evidence from us bank holding companies, *The Journal of Finance* 68, 1757–1803.
- Fahlenbrach, Rüdiger, Robert Prilmeier, and René M Stulz, 2012, This time is the same: Using bank performance in 1998 to explain bank performance during the recent financial crisis, *The Journal of Finance* 67, 2139–2185.

References II

- Fahlenbrach, Rüdiger, and René M Stulz, 2011, Bank CEO incentives and the credit crisis, *Journal of Financial Economics* 99, 11–26.
- Foote, Christopher L, Kristopher S Gerardi, and Paul S Willen, 2012, Why did so many people make so many ex post bad decisions? The causes of the foreclosure crisis, Working paper.
- Heider, Florian, Farzad Saidi, and Glenn Schepens, 2016, Life below zero: Bank lending under negative policy rates, Working paper.
- Ioannidou, Vasso, Steven Ongena, and José-Luis Peydró, 2015, Monetary policy, risk-taking, and pricing: Evidence from a quasi-natural experiment, *Review of Finance* 19, 95–144.
- Jiménez, Gabriel, Steven Ongena, José-Luis Peydró, and Jesús Saurina, 2014, Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking?, *Econometrica* 82, 463–505.
- Mian, Atif, and Amir Sufi, 2009, The Consequences of Mortgage Credit Expansion: Evidence from the US Mortgage Default Crisis, *The Quarterly Journal of Economics* 124, 1449–1496.
- Mian, Atif, and Amir Sufi, 2011, House prices, home equity-based borrowing, and the US household leverage crisis, *American Economic Review* 101, 2132–2156.
- Paligorova, Teodora, and João A.C. Santos, 2016, Monetary policy and bank risk-taking: Evidence from the corporate loan market, *Journal of Financial Intermediation*, forthcoming.
- Saunders, Anthony, Elizabeth Strock, and Nickolaos G Travlos, 1990, Ownership structure, deregulation, and bank risk taking, *The Journal of Finance* 45, 643–654.
- Stulz, René M, 2008, Risk management failures: What are they and when do they happen?, *Journal of Applied Corporate Finance* 20, 39–48.