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Pro-Cyclical Capital Regulation and Lending

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CROATIAN NATIONAL BANK

PRO-CYCLICAL CAPITAL REGULATION AND LENDING

Markus Behn, Rainer Haselmann, Paul Wachtel

19th Dubrovnik Economic Conference

Dubrovnik, June 14th, 2013

Regulation of banks' capital requirements

- Optimal design of capital requirements is one of the key questions in banking literature (Diamond/Rajan 2000; Morrison/White 2005)
- Basel III is in the process of being implemented
- Idea: Capital requirements should reflect asset risk (e.g. Basel I 1988)
- Since Basle II (2007): Introduction of asset-risk-specific capital charges
- Use of internal rating systems to determine capital charges for credit risks

What are the consequences regarding bank lending?

- Positive: Better alignment of regulatory capital with actual asset risk (Basel Committee on Banking Supervision 2004; Bundesbank 2004)
- Negative: Blamed as one factor that contributed to turning the U.S. subprime crisis into world-wide economic crisis (Brunnermeier 2009; Hellwig 2009; Gorton and Metrick 2012)
 - Banks may "economize on equity", contributing to systematic undercapitalization of the banking system (Hellwig 2010)
 - Asset risk may respond to economic conditions and exacerbate pro-cyclicality of capital regulation (e.g. Danielsson et al. 2001; Kashyap and Stein 2004; Repullo and Suarez 2008)

Aim of our paper is to causally identify the effect of asset-specific, risk-based capital charges on banks' lending behavior

- Examine shock to the financial sector (i.e. Lehman collapse)
- Exogenous increase of risk in the economy (Brunnermeier 2009)
- Deterioration of banks' internal risk estimates (PDs)
- Examine whether banks' lending reaction to the shock depends on the regulatory approach used by a bank (or for a certain loan)
- Internal ratings-based (IRB) vs. standard approach (SA)

Three identification concerns beset empirical studies of this question:

- 1 Endogeneity of risk assessment and lending decision
⇒ Exploit crisis shock: Increase of expected future firm PDs
- 2 Firms' demand for loans may change in economic downturns
⇒ Focus on within firm variation in loans (Khwaja and Mian 2008)
- 3 Banks may be affected differently by shocks (differences between banks that adopted model-based approach and banks that did not)
⇒ Exploit institutional details of Basel II introduction

- Model based capital regulation affects lending around a real shock
- IRB institutions reduced loans relatively more than SA institutions
- Within IRB institutions, IRB loans are reduced more than SA loans
- Findings are not explained by differences in firms' demand for loans or a heterogeneous effect of the crisis on banks
- Real effects: Firms that receive a larger fraction of their loans from IRB banks experience a greater reduction in total loans over the crisis

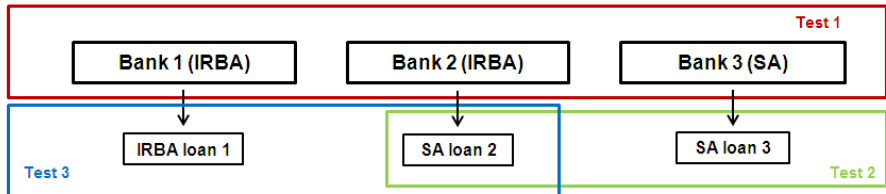
- Jimenez et al. 2013 examine counter-cyclical capital buffers in Spain
- Ayuso et al. 2004 showed that capital buffers are pro-cyclical
- Theoretical literature on the pro-cyclicality of risk-based capital regulation (e.g. Repullo and Suarez 2012, Heid 2007)
- Several policy papers warned about pro-cyclical implications of Basel II (e.g. Borio et al. 2001, Goodhart et al. 2004)
- Implications of bank capital regulation on macroeconomic fluctuations (Blum and Hellwig 1995; Zicchino 2005)

- 1 Introduction
- 2 **Institutional Background and Data**
- 3 Empirical analysis
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- 4 Conclusion

Introduction of Basel II

- Two broad methodologies for determining capital requirements:
 - Standard Approach (SA)
 - Internal Ratings-Based Approach (IRB)
- Banks have to apply for IRB licence and make implementation plan
- Gradual introduction of IRB: Regulatory approach varies within bank
- Shock had differential impact on capital charges of IRB banks:
 - No effect on capital charges for SA loans
 - Changes in PD affect capital charges for IRB loans

INSTITUTIONAL SETUP AND IDENTIFICATION



- Identifying assumption: Assignment of loans to IRB approach not related to size of lending adjustments over the crisis
- Bank and regulator agreed upon implementation plan years before the crisis (Solvabilitätsverordnung, §§ 64-67)
- Portfolio-based introduction of the IRB approach: No individual loans, no switching back to standard approach
- Availability of past data determines order of introduction: Banks start with portfolios where they have enough lending experience

CLASSIFICATION OF IRBA/SA LOANS IN 2008Q1

	Dependent variable: D(IRBA loan)				
	(1)	(2)	(3)	(4)	(5)
Portfolio share	1.899*** (0.474)				3.645** (1.790)
Portfolio PD		-1.194 (2.671)			-6.713 (6.465)
Log loans (pre-event)			0.072 (0.053)		0.048 (0.038)
Log firm assets (pre-event)				0.081 (0.064)	0.067 (0.060)
Firm ROA (pre-event)				0.631 (0.409)	0.607 (0.403)
Firm Leverage (pre-event)				-0.080 (0.109)	-0.080 (0.089)
Firm PD (pre-event)				0.485 (1.929)	0.758 (1.908)
Bank dummies	YES	YES	YES	YES	YES
Observations	87,725	87,725	87,725	10,405	10,405
Pseudo R-squared	0.343	0.340	0.343	0.573	0.575

- German credit register of the Deutsche Bundesbank:
 - Every relationship with exposure above EUR 1.5m is recorded
 - Regulatory approach used by the bank
- Balance sheet data of German banks (BAKIS)
- Balance sheet data of German firms (Amadeus)
- Sample period: 2008Q1 - 2011Q3

Loan-level variables			
	Loans	Mean	S.D.
Loan size in € mn	182,966	15.9	37.6
Change in log lending	182,966	-0.038	0.456
Change in PD	74,241	0.034	0.163
Portfolio share	182,966	0.043	0.076
D(IRBA loan)	182,966	0.336	0.472
Lender type	Commercial	Savings	Cooperative
Percent of loans	32.2%	47.0%	20.7%

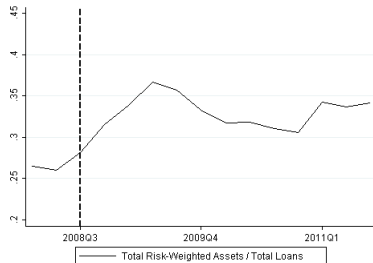
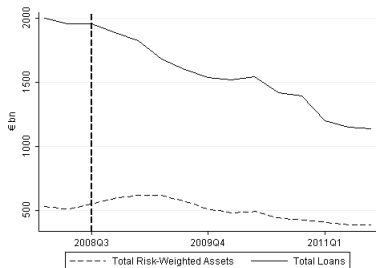
DESCRIPTIVES II

Bank-level variables	SA Banks			IRB Banks		
	Banks	Mean	S. D.	Banks	Mean	S. D.
Number of loans	1,784	51.8	120.0	41	2,106.5	2,997.7
Bank assets in € mn (pre-event)	1,784	1,080	2,580	41	138,000	307,000
Bank equity ratio (pre-event)	1,784	0.067	0.051	41	0.046	0.029
Bank ROA (pre-event)	1,784	0.006	0.012	41	0.006	0.010
Share IRBA	1,784	0	0	41	0.620	0.371
Bank type	Commercial	Savings	Cooperative	Commercial	Savings	Cooperative
Percent of banks	8.7%	24.4%	66.8%	58.5%	31.7%	9.8%

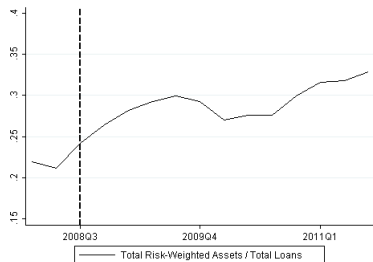
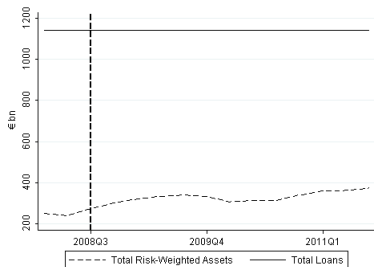
CRISIS EVENT



EFFECT ON RISK WEIGHTED ASSETS (RWA)



EFFECT ON RWA OF CONSTANT LOAN PORTFOLIO



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$$\Delta \log(\text{loans})_{ij} = \alpha_i + \beta \times \text{Share IRB}_j + X_j' \gamma + \kappa \times M_{ij} + \epsilon_{ij}$$

- $\Delta \log(\text{loans})_{ij}$: Difference in the log of loans from bank j to firm i
- Data collapsed into single pre- and post-event time periods by taking time-series averages of loans
- α_i firm fixed effects to account for firm specific credit demand shocks
- Share IRB_j is share of IRB loans within a bank
- β : coefficient of interest identified from variation within the same firm

$$\Delta \log(\text{loans})_{ij} = \alpha_i + \beta \times \text{Share IRB}_j + X_j' \gamma + \kappa \times M_{ij} + \epsilon_{ij}$$

- X_j : Bank control variables (size, capitalization, profitability, type)
- M_{ij} : Bank j 's market share within firm i 's industry segment
- Standard errors are clustered at the bank level to account for potential correlation among changes in loans from the same bank
- Test shows whether the same firm – borrowing from at least two different banks – experiences a larger decline in lending from banks that use the IRB approach for a larger share of their loans

RESULTS - FIXED EFFECTS

	Test 1			Test 2			Test 3				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	Exit	Exit
Share IRBA	-0.081*** (0.020)	-0.053** (0.021)		-0.054** (0.022)	-0.043 (0.038)						
D(IRBA Bank)			-0.032** (0.016)			-0.030 (0.023)					
D(IRBA loan)							-0.039*** (0.012)	-0.040** (0.016)	-0.021* (0.011)	0.044 (0.035)	0.027 (0.028)
Portfolio share		0.133 (0.091)	0.111 (0.089)		0.390** (0.193)	0.374* (0.197)		0.145 (0.143)	0.078 (0.089)	0.163 (0.167)	-0.005 (0.348)
Log bank assets (pre-event)		-0.011** (0.005)	-0.011** (0.005)		-0.007 (0.006)	-0.007 (0.006)		-0.018 (0.015)		-0.042*** (0.013)	
Bank equity ratio (pre-event)		-0.273 (0.376)	-0.171 (0.397)		-0.179 (0.433)	-0.157 (0.435)		-0.540 (1.264)		-0.018 (1.195)	
Bank ROA (pre-event)		-0.003 (0.017)	-0.003 (0.016)		0.016 (0.011)	0.016 (0.011)		-0.107** (0.052)		0.047 (0.080)	
D(state bank)		0.007 (0.022)	0.010 (0.022)		0.034* (0.019)	0.037* (0.019)		-0.018 (0.045)		-0.069* (0.038)	
D(cooperative bank)		0.009 (0.017)	0.014 (0.017)		0.030 (0.018)	0.033* (0.018)		-0.038 (0.026)		-0.097** (0.039)	
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	YES
Observations	93,370	93,370	93,370	49,492	49,492	49,492	27,620	27,620	27,620	27,620	27,620
R-squared	0.27	0.27	0.27	0.25	0.25	0.25	0.30	0.30	0.30	0.44	0.44

RESULTS - OLS

	Test 1			Test 2			Test 3				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	$\Delta\log(\text{loans})$	Exit	Exit
Share IRBA	-0.058*** (0.020)	-0.030* (0.017)		-0.030 (0.034)	-0.034 (0.026)						
D(IRBA Bank)			-0.025* (0.014)			-0.024 (0.015)					
D(IRBA loan)							-0.050*** (0.016)	-0.025** (0.010)	-0.025* (0.013)	0.069* (0.040)	0.028 (0.040)
Portfolio share	0.198 (0.196)	-0.224 (0.200)	-0.231 (0.198)	0.354 (0.225)	0.224 (0.216)	0.205 (0.201)	0.211 (0.253)	-0.295 (0.229)	-0.312 (0.236)	0.569** (0.218)	0.432 (0.296)
Log bank assets (pre-event)	-0.010** (0.004)	-0.004 (0.003)	-0.003 (0.003)	-0.010*** (0.003)	-0.005** (0.002)	-0.005** (0.002)	-0.016 (0.011)	0.001 (0.007)		0.002 (0.013)	
Bank equity ratio (pre-event)	-0.296 (0.301)	-0.341 (0.239)	-0.330 (0.244)	-0.246 (0.355)	-0.371 (0.228)	-0.350 (0.220)	0.471 (0.812)	0.025 (0.541)		0.796 (1.283)	
Bank ROA (pre-event)	-0.000 (0.015)	0.007 (0.009)	0.007 (0.009)	0.012 (0.011)	0.005 (0.008)	0.005 (0.008)	-0.104** (0.038)	-0.007 (0.026)		-0.016 (0.114)	
D(state bank)	0.014 (0.020)	0.007 (0.016)	0.009 (0.016)	0.030* (0.016)	0.026** (0.011)	0.028** (0.011)	-0.024 (0.037)	-0.008 (0.023)		-0.110** (0.043)	
D(cooperative bank)	0.011 (0.018)	0.018 (0.014)	0.022 (0.015)	0.023 (0.017)	0.034*** (0.012)	0.037*** (0.012)	-0.035 (0.023)	-0.003 (0.017)		-0.134** (0.058)	
Constant	0.213** (0.104)	0.074 (0.078)	0.053 (0.075)	0.193*** (0.073)	0.092* (0.056)	0.080 (0.058)	0.394 (0.317)	-0.048 (0.190)		0.694* (0.403)	
Bank FE	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	YES
Observations	93,370	182,966	182,966	49,492	121,549	121,549	27,620	90,500	90,500	90,500	90,500
R-squared	0.005	0.006	0.006	0.003	0.003	0.003	0.003	0.003	0.008	0.038	0.059

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BANK CAPITALIZATION

	Dependent variable: $\Delta \log(\text{loans})$					
	Test 1		Test 2		Test 3	
	(1)	(2)	(3)	(4)	(5)	(6)
Share IRB \times Dummy(low equity)	-0.207** (0.081)		-0.064 (0.102)			
Share IRB \times Preshock bank capitalization		1.897* (1.121)		-1.048 (1.368)		
IRB loan \times Dummy(low equity)					-0.046** (0.020)	
IRB loan \times Bank equity ratio (pre-event)						2.117* (1.057)
Share IRB	-0.016 (0.014)	-0.104** (0.045)	-0.009 (0.023)	0.016 (0.047)		
IRB loan					-0.017 (0.012)	-0.102*** (0.030)
Constant	0.132** (0.065)	0.096 (0.080)	0.071 (0.064)	0.062 (0.063)	0.141 (0.162)	0.121 (0.181)
Bank Controls	YES	YES	YES	YES	YES	YES
Observations	182,966	182,966	121,549	121,549	90,500	90,500
R-squared	0.006	0.005	0.002	0.002	0.004	0.003

LOAN CROSS-SECTION

	Dependent variable: $\Delta \log(\text{loans})$					
	Test 1		Test 2		Test 3	
	(1)	(2)	(3)	(4)	(5)	(6)
Share IRB \times high exposure	-0.133*** (0.039)		-0.045 (0.044)			
Share IRB \times large loan		-0.180*** (0.061)		-0.050 (0.044)		
IRB loan \times high exposure					-0.115** (0.045)	
IRB loan \times large loan						-0.133*** (0.045)
Share IRB	-0.012 (0.021)	0.086** (0.039)	-0.022 (0.024)	0.018 (0.034)		
IRB loan					-0.013 (0.011)	0.066** (0.027)
High exposure	-0.143*** (0.018)		-0.113*** (0.017)		-0.181*** (0.042)	
Large loan		-0.111*** (0.009)		-0.114*** (0.008)		-0.150*** (0.018)
Constant	0.818*** (0.093)	0.020 (0.063)	0.585*** (0.060)	0.070 (0.045)	1.142*** (0.226)	0.121 (0.163)
Bank Controls	YES	YES	YES	YES	YES	YES
Observations	182,966	182,966	121,549	121,549	90,500	90,500
R-squared	0.020	0.043	0.009	0.025	0.023	0.049

FIRM CROSS-SECTION

	Dependent variable: $\Delta \log(\text{loans})$					
	Test 1			Test 3		
	(1)	(2)	(3)	(4)	(5)	(6)
	All firms	Low ROA	High ROA	All firms	Low ROA	High ROA
Share IRB	-0.045** (0.023)	-0.063** (0.030)	-0.022 (0.026)			
IRB loan				-0.032** (0.013)	-0.043** (0.020)	-0.018 (0.019)
Bank controls	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Observations	17,332	8,718	8,614	14,460	7,130	7,330
R-squared	0.362	0.361	0.364	0.324	0.321	0.329

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Firm level regressions:

$$\Delta \log(\text{total firm loans})_i = \beta \times \text{Share (IRB Banks)} + X_i' \gamma + \epsilon_i$$

- $\Delta \log(\text{total firm loans})_i$: Difference in the log of firm i 's total loans
- Data collapsed into single pre- and post-event time periods by taking time-series averages of total firm borrowing
- Firm share IRB: Share of loans the firm receives from IRB banks
- X_i' : Controls (size, profitability, leverage, industry, bank controls)
- Standard errors are clustered by firms' main banks
- Test shows how the share that a firm borrows from IRB banks affects the change in this firm's total loans over the crisis

RESULTS - FIRM LEVEL

	Dependent variable: $\Delta \log(\text{total firm loans})$				Dependent variable: $\Delta \text{capital cost}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share (IRBA Loans)	-0.086*** (0.024)	-0.113*** (0.029)			0.0020*** (0.0008)	0.0017 (0.0011)		
Share (IRBA-IRBA Loans)			-0.097** (0.043)	-0.078* (0.040)			0.0011 (0.0062)	0.0015 (0.0061)
Log firm assets (pre-event)	-0.008 (0.007)	-0.008 (0.007)	0.038*** (0.009)	0.036*** (0.009)	0.0006* (0.0004)	0.0003 (0.0003)	-0.0027 (0.0019)	-0.0025 (0.0019)
Firm ROA (pre-event)	-0.062 (0.059)	-0.070 (0.059)	-0.134 (0.138)	-0.128 (0.138)	-0.0013 (0.0034)	-0.0015 (0.0034)	0.0312* (0.0183)	0.0319* (0.0180)
Firm leverage ratio (pre-event)	-0.102*** (0.035)	-0.109*** (0.035)	-0.230** (0.115)	-0.188 (0.114)	-0.0075*** (0.0022)	-0.0062*** (0.0021)	-0.0065 (0.0115)	-0.0096 (0.0111)
Log bank assets (pre-event)		0.003* (0.002)		-0.003 (0.003)		-0.0001 (0.0001)		-0.0001 (0.0004)
Bank equity ratio (pre-event)		-0.334 (0.510)		-0.537 (2.001)		-0.0380 (0.0452)		0.2400 (0.2697)
Bank ROA (pre-event)		-0.019 (0.024)		0.022 (0.088)		-0.0017 (0.0019)		-0.0067 (0.0114)
Constant	0.020 (0.071)	-0.021 (0.083)	-0.545*** (0.101)	-0.475*** (0.100)	-0.0072* (0.0040)	0.0006 (0.0034)	0.0366* (0.0216)	0.0308 (0.0227)
Observations	7,778	7,778	1,575	1,575	4,977	4,977	1,273	1,273
R-squared	0.011	0.012	0.026	0.028	0.006	0.010	0.0044	0.0055

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- Model based capital regulation affects lending around a real shock
- IRB institutions reduced loans relatively more than SA institutions
- Findings are not explained by differences in firms' demand for loans or a heterogeneous effect of the crisis on banks
- Real effects: Firms that receive a larger fraction of their loans from IRB banks experience a greater reduction in total loans over the crisis
- Provides reasoning for introducing counter-cyclical capital buffers
- Basel III continues to use asset risk specific capital charges

Appendix

MULTI-BANK FIRMS

Panel A: Firm-bank relationships			
	Total	One bank	Multiple banks
Firms	106,285	81,294	24,991
Observations	182,966	81,294	101,672

Panel B: Identifying observations			
	Test 1	Test 2	Test 3
Firms	20,740	10,496	7,167
Observations	93,370	49,492	27,620
a) ... of which from SA bank	44,423	35,852	
... of which from IRB bank	48,947	13,640	
b) ... of which SA loans			9,226
... of which IRB loans			18,394