

## HOW DOES COMPETITION IMPACT BANK RISK TAKING?

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FINANCIAL STABILITY DEPARTMENT

# Outline



- **Motivation and main results**
- **Literature review**
- **Data and description of the empirical model**
- **Results**
- **Concluding remarks**

## Motivation and main results



- **The analysis of the relationship between competition and financial stability is key for banking supervisors and central banks:**
  - **Does competition increase bank risk-taking?**
- **The traditional view: the franchise value paradigm**
  - **More competition erodes the franchise value of the bank, encouraging more risk taking and, thus, more NPL and bank insolvencies (Keeley 1990, AER)**
  - **Widely supported theoretically and empirically**

## Motivation and main results

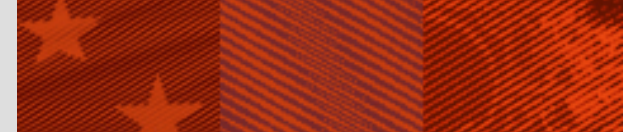


- **Recently, Boyd and De Nicolo (2005) have challenged the traditional view:**
  - **less competition means higher interest rates charged to business loans, which increases credit risk of borrowers (i.e. more difficult to repay and moral hazard) and, thus, financial fragility**
- **Risk-shifting paradigm: competition enhances financial stability**
- **Martínez-Miera and Repullo (2007) extend the Boyd-De Nicolo model and allow for U-shaped relationship between competition and risk**
- **Shall bank supervisors abandon the franchise value paradigm?**

## Motivation and main results

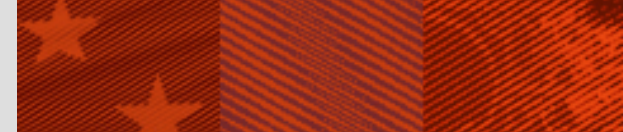
- **Objective: to test the relationship between competition and bank risk**
- **Focus on the Spanish banking market...**
- **...taking advantage of a detailed database:**
  - **marginal interest rates of banking products, controlling for risk premium, allows a precise Lerner index (market power measure) vs standard use of concentration measures**
  - **NPL ratios of business loans (focus closer on Boyd/DeNicolo and Martínez-Miera/Repullo models)**
- **Quadratic specification to acomodate M-M/R model**
- **We find clear support for the traditional franchise value paradigm**

## Literature review-Theoretical papers



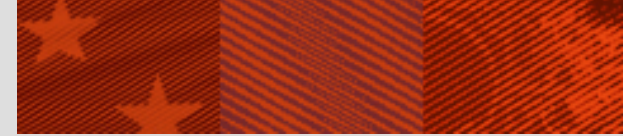
- **Long tradition of a trade off between competition and solvency**
  - **Static models (Marcus, 1984; Dermine, 1986)**
  - **Two-period models (Keeley (1990)**
  - **Infinite horizon (Suárez, 1994)**
  - **Different competition measures:**
    - *number of banks (Broecker, 1990; Márquez, 2002)*
    - *product differentiation (Matutes & Vives, 1996,2000)*

## Literature review-Theoretical papers



- **Boyd and De Nicolo (2005)**
  - More market power of in loan markets means higher loan rates which, assuming moral hazard, leads borrowers to increase their risk (risk shifting), increasing NPL.
  - Negative relationship between the number of lenders in a market (degree of competition) and the level of bank risk
  
- **Martínez-Miera and Repullo (2007)**
  - reconcile the risk shifting and the franchise value including a higher margin effect coming from those firms that repay their loans at higher rates (imperfect correlation across firms)
  - U-shaped relationship between the number of banks in a market and the level of risk

## Literature review-Empirical papers



- **Many papers find a positive relationship between competition and bank risk**
  - Keeley (1990): solvency ratio and CD cost vs Tobin's q
  - Brewer and Saldenbergh (1996): volatility of stock prices
  - Salas and Saurina (2003): solvency and NPL ratios vs Tobin's q
  - Cross-country setting (Beck et al (2006), Levy Yeyati & Micco(2007))
- **Few papers find more competition and less risk**
  - Boyd, De Nicolo & Al Jalal (2006), rural US banks and 134 countries z-score, volatility of ROA and equity ratio vs Herfindahl index
  - Jayaratne and Strahan (1998), credit quality increases with bank deregulation
  - Mixed results: either good measures of bank risk or good measures of bank competition but not both
- **Our contribution: a precise definition of bank risk and degree of competition**



# Data



- **Measure of bank risk**
  - **NPL ratio of commercial loans**
  - **Data coming from our Credit Register (CIR)**
    - *all loans over 6,000 euros, all lenders in Spain*
    - *full census of Spanish corporate borrowing*
    - *even information at product level (receivables, credit lines)*
  
- **Loan failure rate is key in Boyd/De Nicoló and M-M/R models**
  
- **NPL include 90 days overdue commercial loans + doubtful commercial loans (forward looking to a certain extent)**

## Data



- **Measure of bank competition**
- **Standard concentration measures:**
  - number of banks (B/DN & M-M/R models)
  - percentage of market captured by top 5 banks (C5)
  - HHI measures
  - Bank-level averages across the 50 Spanish provinces with weights being bank's portfolio share.
  
- **However, concentration is not a good proxy for the degree of market competition (Classens & Laeven (2004), among others).**
- **For our study, we use the Banco de España database of bank's average marginal interest rates for an array of banking products to calculate Lerner indexes, which are a measure of market power based on price setting ability**

## Data

- The simple formula for a Lerner index is  $L = 1 - MC / P$ , where MC and P denote marginal cost and price
- Perfect competition leads to  $MC = P$ , and  $L = 0$ . As market power increases with P, L increases
- For bank loans, credit risk must be factored into the calculations, and we can do so by using the CIR dataset
- Assuming risk neutrality, marginal cost (R) verifies:

$$(1+r) = (1-PD)(1+R) + PD(1+R)(1-LGD)$$

$$R = (r + PD*LGD) / (1 - PD*LGD)$$

- where PD is the loan's probability of default, LGD is its loss percentage given default and r is the risk-free interest rate
- Thus, we control for the risk premium when calculating the Lerner indexes of loans in order to obtain the more exact measure of market power

## Data

- For our calculations, for each bank  $i$  and each year  $t$  in our sample and for each loan product  $m$ ,

$$L_{mit} = 1 - \frac{R_{mit}}{P_{mit}},$$

- $R_{mit}$  is our estimated marginal cost (based on  $PD_{mit}$  equal to the bank's defaulted loan rate on product  $m$  from the CIR; LGD is set at 45%)
  - $P_{mit}$  is the bank's marginal reported interest rate on product  $m$
- For deposit products, Lerner index is computed as

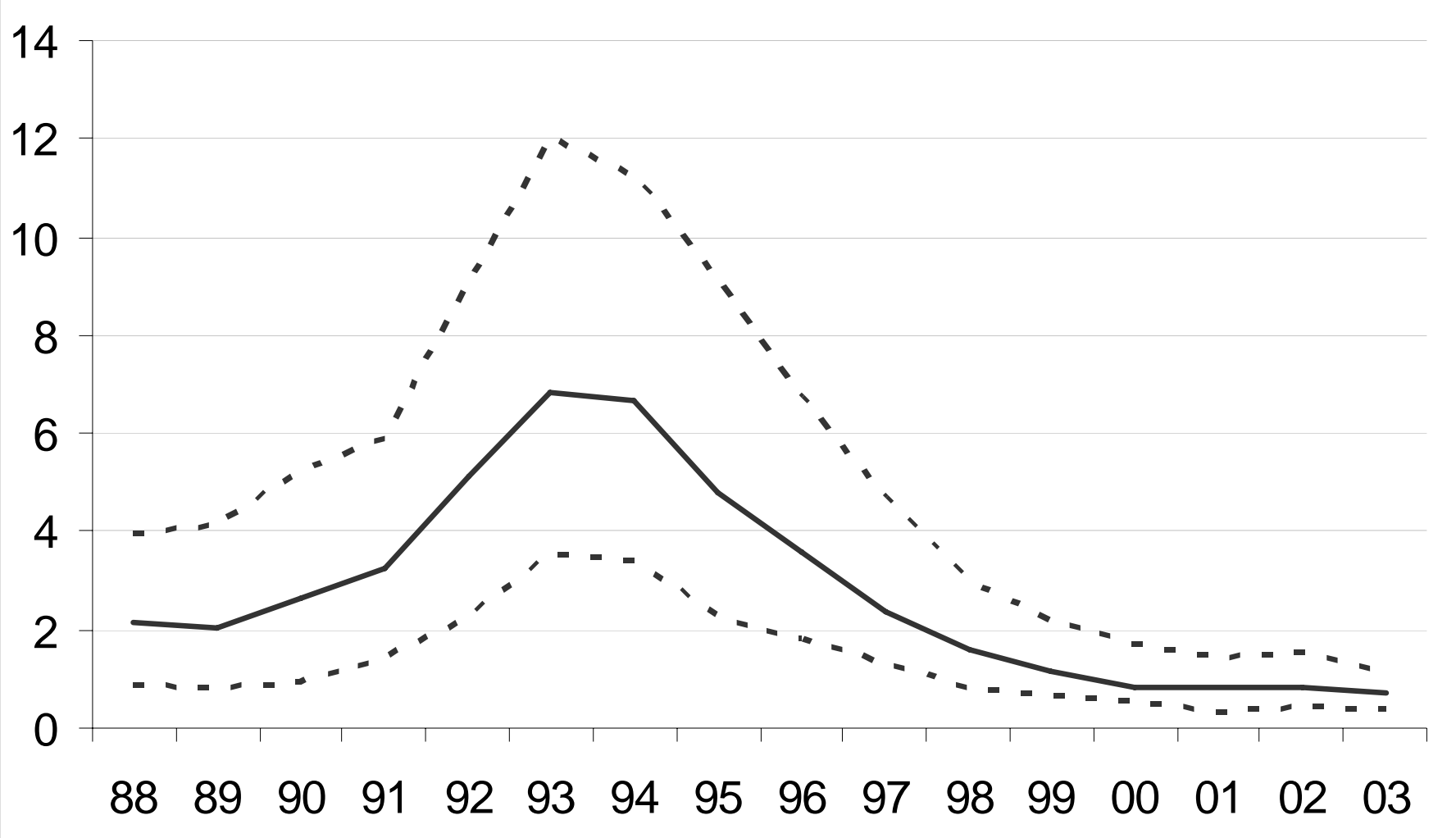
$$L_{mit} = 1 - \frac{P_{mit}}{r_{interbank}}$$

## Data

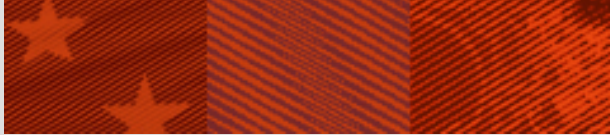
- **We also control for individual bank characteristics using balance sheet and P&L data**
- **We control for cyclical variables (GDP growth)**
- **Focus on commercial and savings banks (95% of market)**
- **Period spans from 1988-2003 (availability of Lerner index data)**
- **1,632 observations; mergers properly treated**
- **Loan products: corporate credit lines, receivables, total loans**
- **Deposit products: total deposits, demand deposits, repo transactions)**

<b>Variables</b>	<b>Mean</b>	<b>S.D</b>	<b>Mean</b>	<b>Minimum</b>	<b>Maximum</b>
NPL <sub>it</sub>	4.44	4.93	2.66	0.00	38.02
GDPG <sub>t</sub>	2.92	1.56	2.76	-1.03	5.04
Real interest rate <sub>t</sub>	3.57	2.85	3.56	-0.67	8.12
Share of the bank <sub>it</sub>	0.70	1.27	0.28	0.00	9.32
Loans to firms/Total assets <sub>it</sub>	25.41	12.55	23.00	0.08	90.14
ROA <sub>it</sub>	0.66	1.19	0.72	-16.19	11.08
Number of banks <sub>it</sub>	75.93	24.77	73.00	22.00	148.00
C5_loans <sub>it</sub>	57.73	6.60	58.44	40.00	74.25
Her_loans_firms <sub>it</sub>	8.22	1.86	8.09	4.14	15.02
Lerner_receivables <sub>it</sub>	0.15	0.39	0.19	-7.96	0.64
Lerner_credit_lines <sub>it</sub>	-0.10	0.50	0.00	-6.09	0.70
Lerner_loans <sub>it</sub>	0.05	0.53	0.11	-12.27	0.52
C5_deposits <sub>it</sub>	68.00	5.61	67.35	53.70	84.64
Her_deposits <sub>it</sub>	16.77	3.67	16.33	7.58	28.57
Lerner_REPO_operations <sub>it</sub>	0.09	0.11	0.07	-1.24	0.67
Lerner_sight_accounts <sub>it</sub>	0.45	0.17	0.43	-0.35	0.77
Lerner_deposits <sub>it</sub>	0.35	0.11	0.36	-0.49	0.68
Lerner_loans+Lerner_deposits <sub>it</sub>	0.40	0.56	0.47	-11.82	1.05

# Non-performing loan ratio

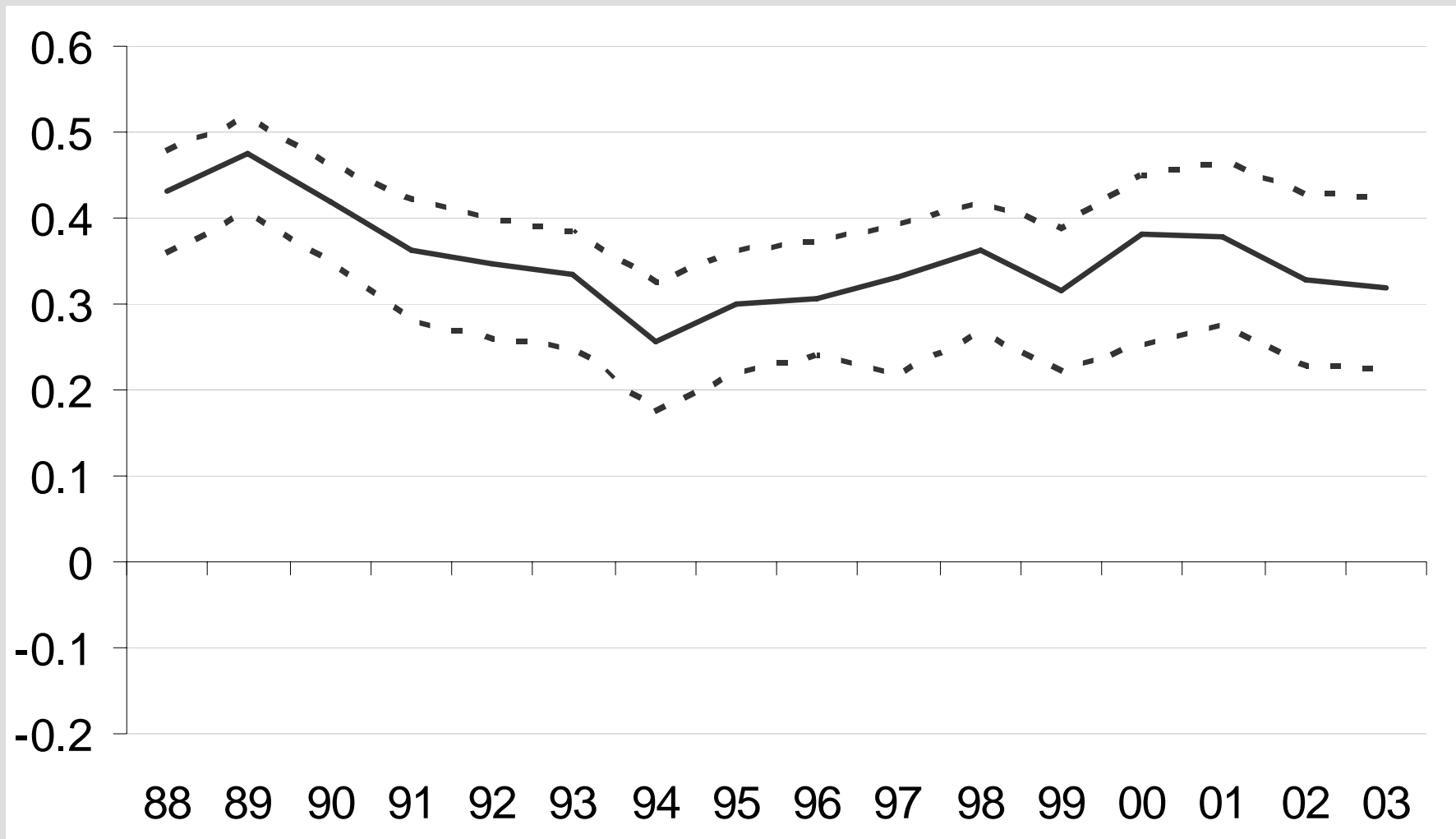
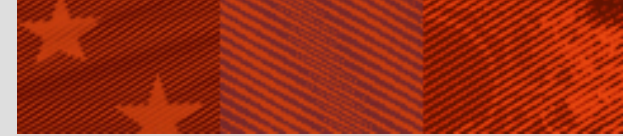


# Lerner index for total loans (interquartile range)





# Lerner index for total deposits (interquartile range)



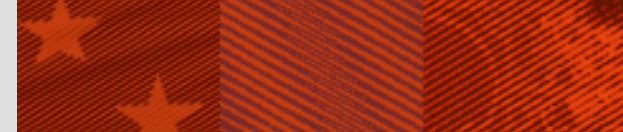


## Correlations



- **Negative relationship between all measures of bank market power (in particular, from loan markets) and commercial NPL**
- **Thus, correlation analysis supports the franchise value paradigm**
- **Strong negative correlation between the number of banks in a market and the concentration variables (C5 and HHI)**
- **C5 and HHI highly correlated**
- **Low positive correlation between Lerner indexes and concentration variables**
- **Low correlation between Lerner of loan and deposit markets**

## Correlations



### Correlation matrix of bank structure measures

$L_{\text{loans}}$	1.00				
$L_{\text{lines}}$	0.72	1.00			
$L_{\text{receiv}}$	0.55	0.14	1.00		
<hr/>					
$L_{\text{deposit}}$	0.12		1.00		
$L_{\text{repo}}$	-0.12		0.31	1.00	
$L_{\text{sight}}$	0.10		0.75	-0.08	1.00
<hr/>					
#banks	-0.30		-0.19		
$C5_{\text{loans}}$	0.21		0.17		
$C5_{\text{deposit}}$	0.29		0.16		
$HHI_{\text{loans}}$	0.19		0.12		
$HHI_{\text{deposit}}$	0.20		0.16		

## Empirical model

$$RISK_{it} = f(\text{COMPETITION INDEX}_{it}, \text{BUSINESS CYCLE}_{it}, \text{BANK CONTROL VARIABLES}_{it})$$

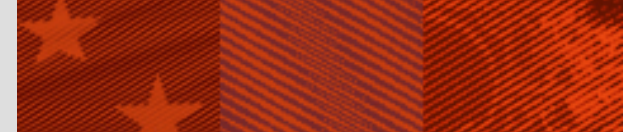
where *i* is bank and *t* year

- The specific model to be estimated is:

$$\ln\left(\frac{NPL_{it}}{100 - NPL_{it}}\right) = \alpha + \beta \ln\left(\frac{NPL_{it-1}}{100 - NPL_{it-1}}\right) + \delta_1 \text{COMPETE}_{it} + \delta_2 \text{COMPETE}^2 + \gamma_1 \text{GDPG}_t + \gamma_2 \text{GDPG}_{t-1} + \varphi_1 \text{ROA}_{it} + \varphi_2 \text{SIZE}_{it} + \varphi_3 \text{LOAN RATIO}_{it} + \eta_i + \varepsilon_{it}.$$

- We allow for a non-linear relationship between risk and competition, as in M-M/R (2007)
- We take first differences and GMM
- + and significant values for  $\delta_1$  and  $\delta_2$  would support the risk shifting
  - and significant values would support the franchise value paradigm
  - opposite signs would support the M-M/R comprehensive view

# Baseline model – Loan market



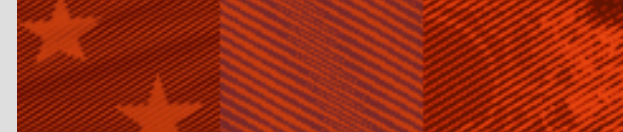
Dependant variable	Model 1		Model 1		Model 1		Model 1		Model 1		Model 1	
$X_{it}$	Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))		Ln(NPL <sub>it</sub> /NPL <sub>it</sub> )		Ln(NPL <sub>it</sub> /NPL <sub>it</sub> )		Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))		Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))		Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))	
Estimation method	GMM First Differences		GMM First Differences		GMM First Differences		GMM First Differences		GMM First Differences		GMM First Differences	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
<b>Persistence</b>												
Ln(NPL <sub>it-1</sub> /(100-NPL <sub>it-1</sub> ))	0.529	7.24 ***	0.516	7.98 ***	0.522	8.04 ***	0.503	9.03 ***	0.436	7.42 ***	0.494	8.72 ***
GDPG <sub>t</sub>	-0.147	-12.03 ***	-0.155	-12.10 ***	-0.151	-12.03 ***	-0.134	-11.39 ***	-0.118	-10.36 ***	-0.122	-10.58 ***
GDPG <sub>t-1</sub>	-0.035	-1.75	-0.024	-1.54	-0.036	-2.21 **	-0.063	-5.12 ***	-0.041	-3.17 ***	-0.059	-4.66 ***
$X_{it}$	-5.584	-1.11	-0.040	-0.58	-0.215	-1.83 *	-0.694	-4.7 ***	-1.423	-6.43 ***	-0.937	-5.1 ***
$X_{it}^2$	1.645	1.39	0.000	0.41	0.010	1.48	-0.074	-4.15 ***	-0.443	-3.97 ***	-0.079	-4.46 ***
Share of the bank <sub>it</sub>	-0.711	-3.00 ***	-0.570	-2.85 ***	-0.535	-2.69 ***	-0.451	-2.99 ***	-0.393	-2.80 ***	-0.498	-3.34 ***
Loans to firms/Total assets <sub>it</sub>	-0.028	-4.24 ***	-0.032	-3.97 ***	-0.028	-3.53 ***	-0.023	-2.97 ***	-0.011	-1.65	-0.014	-1.89 *
ROA <sub>it</sub>	-0.028	-0.66	-0.031	-0.69	-0.025	-0.56	-0.072	-0.91	-0.055	-1.06	-0.017	-0.26
No. Observations	1,262		1,262		1,262		1,155		1,155		1,155	
F test (p-value)	0.000		0.000		0.000		0.000		0.000		0.000	
Test 1 <sup>st</sup> order serial correlatoin (m1) /p-value	-3.90	0.00	-5.23	0.00	-5.26	0.00	-4.48	0.00	-4.36	0.00	-4.36	0.00
Test 2 <sup>nd</sup> order serial correlatoin (m2) /p-value	-1.47	0.14	-1.60	0.11	-1.54	0.12	-1.46	0.14	-1.23	0.22	-1.34	0.18
Hansen test (p-value)	1.00		1.00		1.00		1.00		1.00		1.00	
Bank fixed effects, $\eta_i$	yes		yes		yes		yes		yes		yes	

## Baseline model – Loan market



- **Significant persistency in NPL**
- **GDP impacts on NPL quite quickly (main effect the first year)**
- **Larger banks have lower NPL (benefits of diversification)**
- **The more specialization in commercial loans, the lower the NPL ratio**
- **Negative, although not significant relationship between ROA and NPL**
- **Sargan tests of validity of instruments are very well passed**
- **As expected (because of first differences), first order autocorrelation, no second order autocorrelation**

# Baseline model – Loan market



	Model 1		Model 1		Model 1		Model 1		Model 1		Model 1	
Dependant variable	Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))		Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))		Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))		Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))		Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))		Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))	
X <sub>it</sub>	Ln(# banks)		C5_loans		Her_loans_firms		Lerner_receivables		Lerner_credit_lines		Lerner_loans	
Estimation method	GMM First Differences		GMM First Differences		GMM First Differences		GMM First Differences		GMM First Differences		GMM First Differences	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
<b>Persistence</b>												
X <sub>it</sub>	-5,584	-1,11	-0,040	-0,58	-0,215	-1,83	-0,694	-4,7	-1,423	-6,43	-0,937	-5,1
X <sub>it</sub> <sup>2</sup>	1,645	1,39	0,000	0,41	0,010	1,48	-0,074	-4,15	-0,443	-3,97	-0,079	-4,46



## Baseline model – Loan market



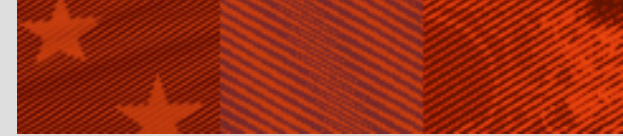
- **The number of banks operating in a market has no impact on banks' risk behaviour**
  - **No support for the risk shifting paradigm**
- **C5 have no impact on banks' risk behaviour**
- **HHI have no significant impact on banks' risk behaviour and, if any, would be negative, thus, supporting franchise value theory**
- **However, increases in Lerner indexes bring about declines in NPL**
  - **Support for the franchise value paradigm**

# Baseline model – Deposit market



	Model 1	Model 1	Model 1	Model 1	Model 1	Model 1						
Dependant variable	Ln(NPL <sub>it</sub> /NPL <sub>it</sub> )	Ln(NPL <sub>it</sub> /NPL <sub>it</sub> )	Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))	Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))	Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))	Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))						
X <sub>it</sub>	C5_deposits	Her_deposits	Lerner_REPO_operations	Lerner_sight_accounts	Lerner_deposits	Lerner_loans+Lerner_de						
Estimation method	GMM First Differences	GMM First Differences	GMM First Differences	GMM First Differences	GMM First Differences	GMM First Differences						
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
<b>Persistence</b>												
Ln(NPL <sub>it-1</sub> /(100-NPL <sub>it-1</sub> ))	0.505	7.38 ***	0.498	7.30 ***	0.577	10.19 ***	0.541	7.42 ***	0.572	9.14 ***	0.496	8.07 ***
GDPG <sub>t</sub>	-0.139	-10.06 ***	-0.138	-11.11 ***	-0.147	-14.27 ***	-0.151	-13.47 ***	-0.149	-12.90 ***	-0.126	-10.57 ***
GDPG <sub>t-1</sub>	-0.041	-2.36 **	-0.046	-2.68 ***	-0.048	-4.04 ***	-0.030	-1.74 ·	-0.012	-0.75	-0.037	-2.77 ***
X <sub>it</sub>	0.426	2.48 **	0.161	2.43 **	0.191	0.46	0.218	0.31	0.440	0.51	-0.855	-4.88 ***
X <sub>it</sub> <sup>2</sup>	-0.004	-2.660 ***	-0.005	-3.15 ***	0.075	0.08	-0.924	-1.340	-1.719	-1.69 ·	-0.078	-4.99 ***
Share of the bank <sub>it</sub>	-0.609	-3.17 ***	-0.531	-2.87 ***	-0.435	-2.60 **	-0.445	-2.98 ***	-0.534	-3.31 ***	-0.534	-3.23 ***
Loans to firms/Total assets <sub>it</sub>	-0.017	-1.98 **	-0.028	-3.86 ***	-0.026	-3.30 ***	-0.033	-3.88 ***	-0.035	-4.49 ***	-0.017	-2.31 **
ROA <sub>it</sub>	-0.035	-0.77	-0.013	-0.32	0.003	0.08	-0.086	-0.90	-0.068	-0.83	-0.013	-0.26
No. Observations	1,262		1,262		1,155		1,155		1,155		1,155	
F test (p-value)	0.000		0.000		0.000		0.000		0.000		0.000	
Test 1 <sup>st</sup> order serial correlatoin (m1) /p-value	-5.17	0.00	-5.15	0.00	-4.42	0.00	-4.25	0.00	-4.40	0.00	-4.23	0.00
Test 2 <sup>nd</sup> order serial correlatoin (m2) /p-value	-1.26	0.21	-1.43	0.15	-0.68	0.50	-1.31	0.19	-1.13	0.26	-1.22	0.22
Hansen test (p-value)	1.00		1.00		1.00		1.00		1.00		1.00	
Bank fixed effects, η <sub>i</sub>	yes		yes		yes		yes		yes		yes	

# Baseline model – Deposit market



	Model 1	Model 1	Model 1	Model 1	Model 1	Model 1
Dependant variable	Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))	Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))	Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))	Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))	Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))	Ln(NPL <sub>it</sub> /(100-NPL <sub>it</sub> ))
X <sub>it</sub>	C5_deposits	Her_deposits	Lerner_REPO_operations	Lerner_sight_accounts	Lerner_deposits	Lerner_loans+Lerner_deposits
Estimation method	GMM First Differences	GMM First Differences	GMM First Differences	GMM First Differences	GMM First Differences	GMM First Differences
<b>Persistence</b>	<i>Coefficient</i> <i>t-statistic</i>	<i>Coefficient</i> <i>t-statistic</i>	<i>Coefficient</i> <i>t-statistic</i>	<i>Coefficient</i> <i>t-statistic</i>	<i>Coefficient</i> <i>t-statistic</i>	<i>Coefficient</i> <i>t-statistic</i>
X <sub>it</sub>	0,426 2,48 **	0,161 2,43 **	0,191 0,46	0,218 0,31	0,440 0,51	-0,855 -4,88 ***
X <sub>it</sub> <sup>2</sup>	-0,004 -2,66 ***	-0,005 -3,15 **	0,075 0,08	-0,924 -1,340	-1,719 -1,69 *	-0,078 -4,99 ***

## Baseline model – Deposit market



- **Non-linear relationship between deposit concentration measures and bank risk, supporting Martínez-Miera and Repullo (2007)**
- **For low values of the concentration indexes the linear result dominates, showing that more concentrated markets are riskier**
- **However, as the number of banks increases (less concentration, more competition potentially) the risk increases**
- **In 94% and 76% of the times, the franchise value is not rejected**
- **Deposit Lerner indexes have almost no impact on bank NPL, reinforcing separation of loan and deposit markets**
- **In any case when loan and deposit Lerner indexes are considered together, more market power means less risk taking by banks**

## Baseline model – Robustness



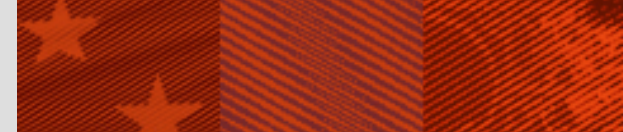
- Adding real interest rates does not change baseline model results
- Including all available instruments does not change baseline model results
- No qualitative change when including a solvency ratio, log of total assets or time dummies
- Including only a linear term for concentration and market power measures reinforces results:
  - + and very significant impact of the # of banks on risk taking (against risk shifting)
  - C5 and HHI weakly supporting franchise value or not significant
  - the 3 Lerner indexes are negative, supporting franchise value, although not all significant

## Baseline model – Robustness



- **Finally, we have run the model specifically for NPL of receivables (credit lines) as a function of the number of banks, the C5, the HHI and the Lerner index for the receivables (credit lines) market**
- **No significant impact of number of banks, C5 and HHI on both NPL ratios, different signs (supporting in any case the M-M/R model)**
- **Negative and very significant impact of the Lerner of receivables (both  $\delta_1$  and  $\delta_2$ ) and credit lines on NPL ratios of receivables and credit lines, respectively**
- **Therefore, robust support for the franchise value paradigm**

## Conclusions



- **We tested the relationship between competition and risk in banks**
- **Different approaches: franchise value, Boyd and De Nicolo (2005) risk-shifting and comprehensive approach by Martínez-Miera and Repullo (2007)**
- **Only Spanish data, but very precise measures of bank risk and bank competition (i.e. market power)**
- **No impact of number of banks in bank risk**
- **No impact of C5 and HHI on bank risk**
- **Increases in market power, measured by Lerner indexes, lead to declines in NPL ratios**
- **Robust support for the franchise value paradigm**



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THANKS FOR YOUR ATENTION

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