Optimal versus realized bank credit risk and monetary policy

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Motivation

Banking is a risky business. Bank managers make risky decisions to produce profits. However, they can also produce large losses.

Profit maximizing level of credit risk?

Is the realized credit risk equal to the optimal?

What are the implications of a discrepancy for the monetary and macro-economic environment?

Methodology - Main Results

Bank managers maximize short run profits

The optimal (profit maximizing) credit risk is different than the realized

It changes in time

Monetary policy affects both the optimal and the realized credit risk

It always increases the gap between them

Related Literature

Theoretical banking:

Hughes and Mester (1994), John, Saunders and Senbet (2000), Agur and Demertzis (2012)

Empirical banking:

Goddard, Molyneux and Wilson (2004), Berger, Hasan and Zhou (2010), Barakova and Pavlia (2014)

Risk-taking chanel

Borio and Zhu (2012), Agur and Demertzis (2013), Ioannidou, Ongena and Peydro (2014)

Imperfections-Regulation

Angeloni and Faia (2010), Acharaya, Engle and Pierret (2014), Duran and Lozano-Vivas (2014), Kaufman (2014)

The model

$$\pi_{it} = \beta_0 + \beta_1 \pi_{it-1} + \beta_2 r_{it-1} + \beta_3 (r_{it-1})^2 + \beta_4 c_{it-1} + u_{it},$$
$$u_{it} = \mu_i + v_t + \varepsilon_{it}$$

Second order risk term that allows for a concave function

All variables are lagged once to avoid reverse causality

Profits:	roa, roe
Risk:	Basel I risk-weighted assets/total assets
c1	liquidity, bank size, capital, non-interest rate income
c2	problem loans, loan-loss provisions
c3	growth, credit by banks
c4	Taylor rule residuals
μ_i	bank regulation
v_t	herding behaviour

Data

Bank level data from FDIC Call Reports

Quarterly, 1996q1-2011q4

N=14,359 banks, T=64 quarters, unbalanced panel

Total: 574,532 observations

Prominent regressions

Dependent variable	ROA	ROA	ROA	ROA	ROA	ROE
ROA $_{t-1}$	0.513***	0.503***	0.483***	0.480***	0.882***	
	(54.055)	(49.960)	(46.085)	(35.473)	(20.973)	
ROE $_{t-1}$						0.521***
						(78.613)
Risk-weighted assets $_{t-1}$	0.033***	0.037***	0.043***	0.748***	0.186***	0.139***
	(10.726)	(11.846)	(11.736)	(5.981)	(3.270)	(7.361)
Risk-weighted assets^2 $_{t-1}$	-0.024***	-0.026***	-0.030***	-0.530***	-0.128***	-0.097***
	(-10.853)	(-11.500)	(-11.228)	(-6.014)	(-3.137)	(-6.858)
Bank size $_{t-1}$	-0.001***	0.001***	0.001***	-0.003***	0.005	0.005***
	(-14.341)	(11.999)	(11.459)	(-6.825)	(1.029)	(7.112)
Capital $_{t-1}$	-0.018***	-0.013***	-0.012***	0.013***	0.068**	-0.093***
	(-16.383)	(-11.323)	(-10.175)	(2.435)	(2.369)	(-15.836)
Liquidity $_{t-1}$	-0.003***	-0.002***	-0.004***	0.020***	0.022	-0.027***
	(-6.118)	(-5.121)	(-8.271)	(4.684)	(0.608)	(-7.724)
Non-interest income $_{t-1}$	0.006***	0.008***	0.008***	0.003***	0.013	0.063***
	(9.214)	(12.308)	(11.416)	(4.070)	(0.624)	(12.501)
Problem loans $_{t-1}$	-0.079***	-0.069***	-0.074***	-0.087***	-0.094	-0.896***
	(-30.994)	(-28.153)	(-27.756)	(-27.757)	(-0.931)	(-28.057)
Provisions $_{t-1}$	0.005	0.000	-0.009	0.082***	0.443	-0.299***
	(0.576)	(-0.022)	(-0.960)	(4.892)	(1.332)	(-4.937)
Growth $_{t-1}$			-0.007***			
			(-4.146)			
Credit by banks $_{t-1}$			0.000***			
			(8.191)			
Optimal point	**0.687*** **	**0.711*** **	**0.716*** **	**0.700*** **	**0.727*** **	**0.715*** **
Quarter fixed effects	No	Yes	No	Yes	Yes	Yes
R-square (overall)	0.356	0.390	0.364			0.378

Time-varying optimal

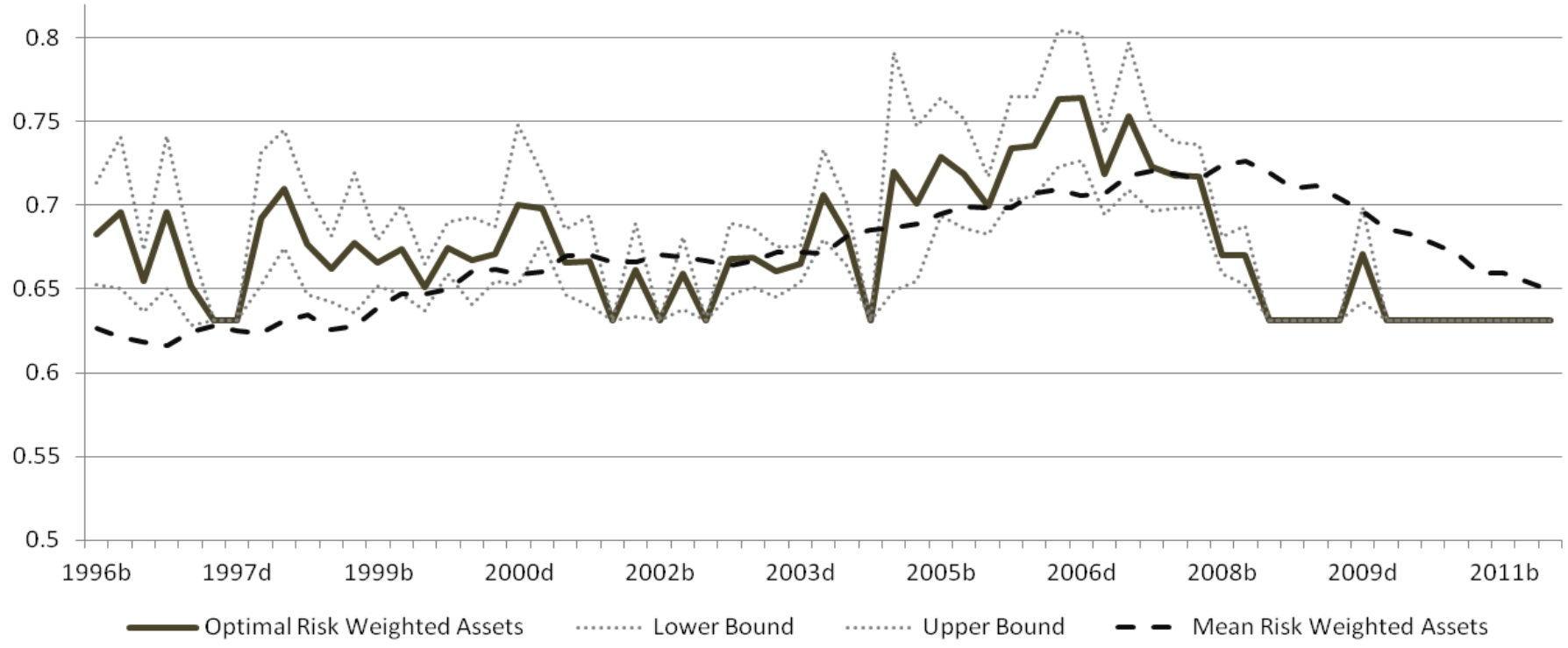
Consider the regression

$$\pi_{it} = \beta_0 + \beta_1 \pi_{i,t-1} + \beta_2 r_{i,t-1} + \beta_3 r_{i,t-1}^2 + \beta_4 c_{i,t-1} + \sum_{j=3}^{T} f_j \, q_j r_{i,t-1} + \sum_{j=3}^{T} g_j \, q_j r_{i,t-1}^2 + \sum_{j=3}^{T} h_j q_j + u_{it}$$

the optimal level of credit risk at each quarter t

$$\frac{\partial \pi_t}{\partial r_{t-1}} = 0 => r_{t-1} = -\frac{\beta_2 + f_j}{2(\beta_3 + g_j)}$$

Optimal versus Average Credit Risk



Monetary policy

The banking sector is important in shaping macroeconomic outcomes

Monetary policy affects both the cost of debt financing and the optimal debt choice – both the realized and optimal credit risk

Thus, the two indicators allow drawing some new insights

Empirical Analysis

$$\Delta Y_t = c + KY_{t-p} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + e_t$$

Y=(federal funds rate, optimal bank risk, realized bank risk, real GDP growth)

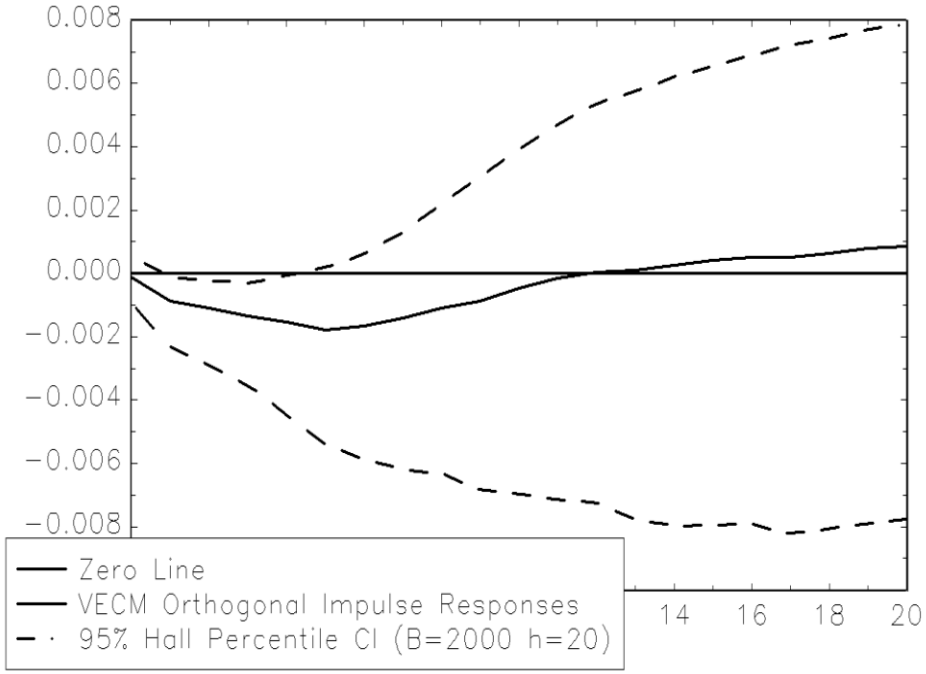
Unit root tests show that all variables are I(1)

1 co-integrating vector

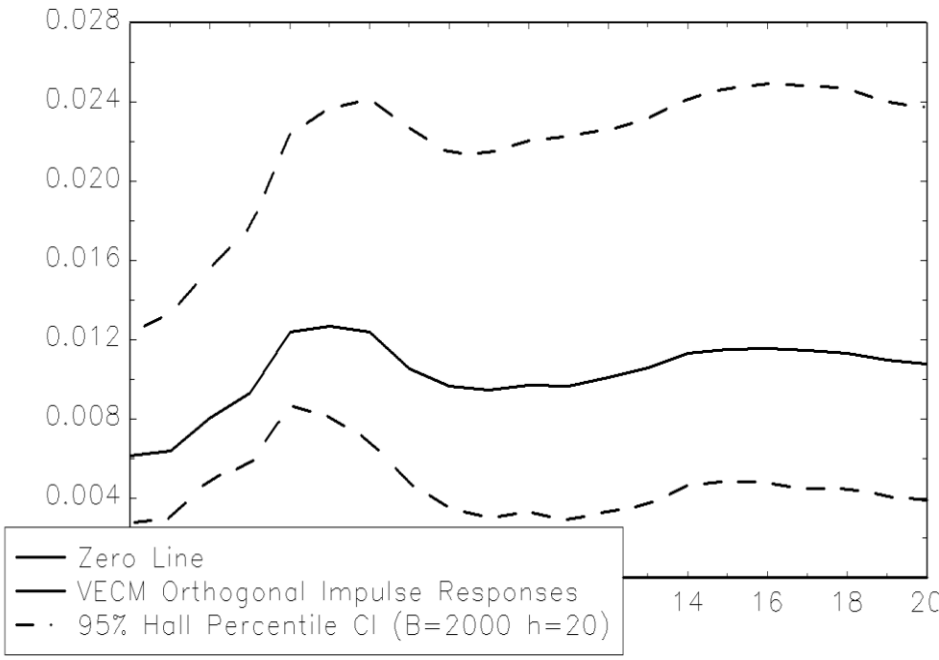
Post estimation tests of normality, serial correlation and structural change are clean

Impulse response functions

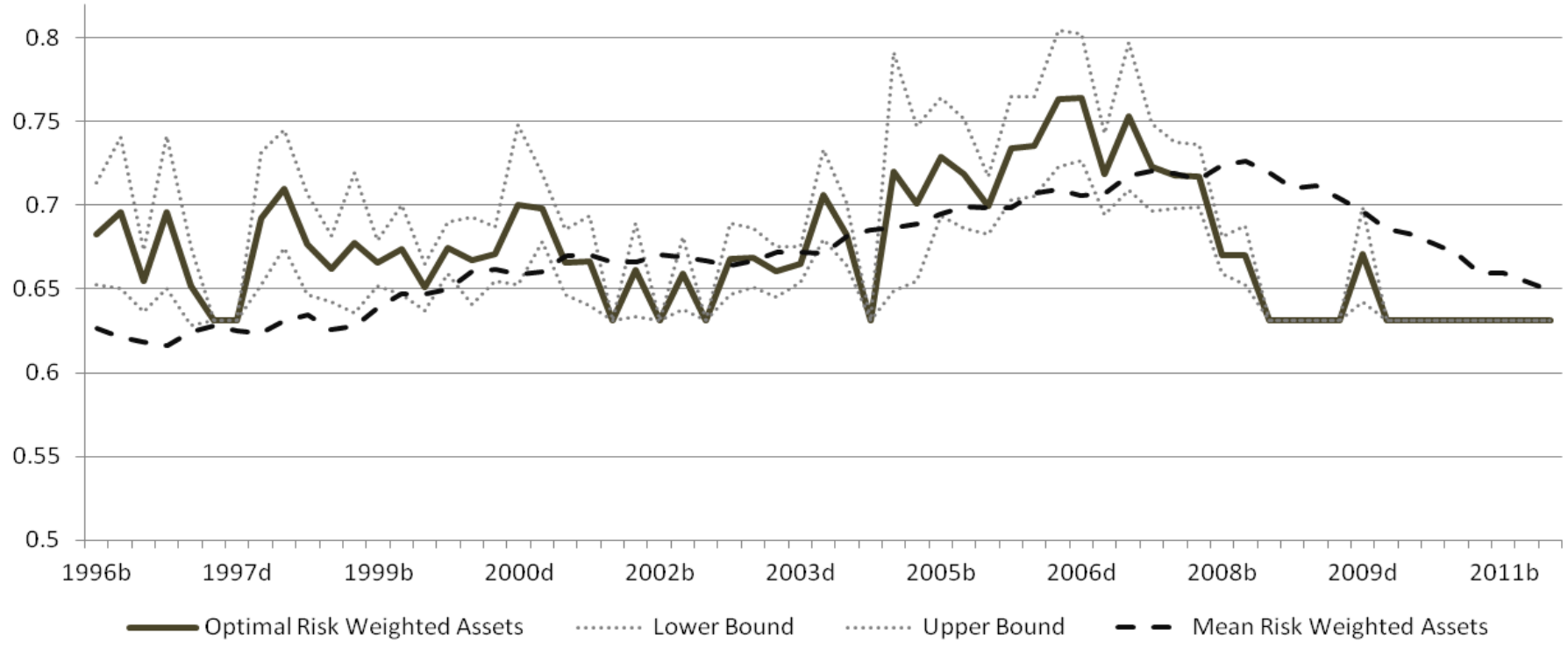
Response of **realized risk** to a monetary policy shock



Response of **optimal risk** to a monetary policy shock



Optimal versus Average Credit Risk



Conclusions

Identification of optimal credit risk

This optimal leads the business cycle. In good periods it is above the realized level while in periods of stress it is below.

The optimal monetary policy in smoothing business cycles always leads to an increase in the gap between the optimal and realized risk.

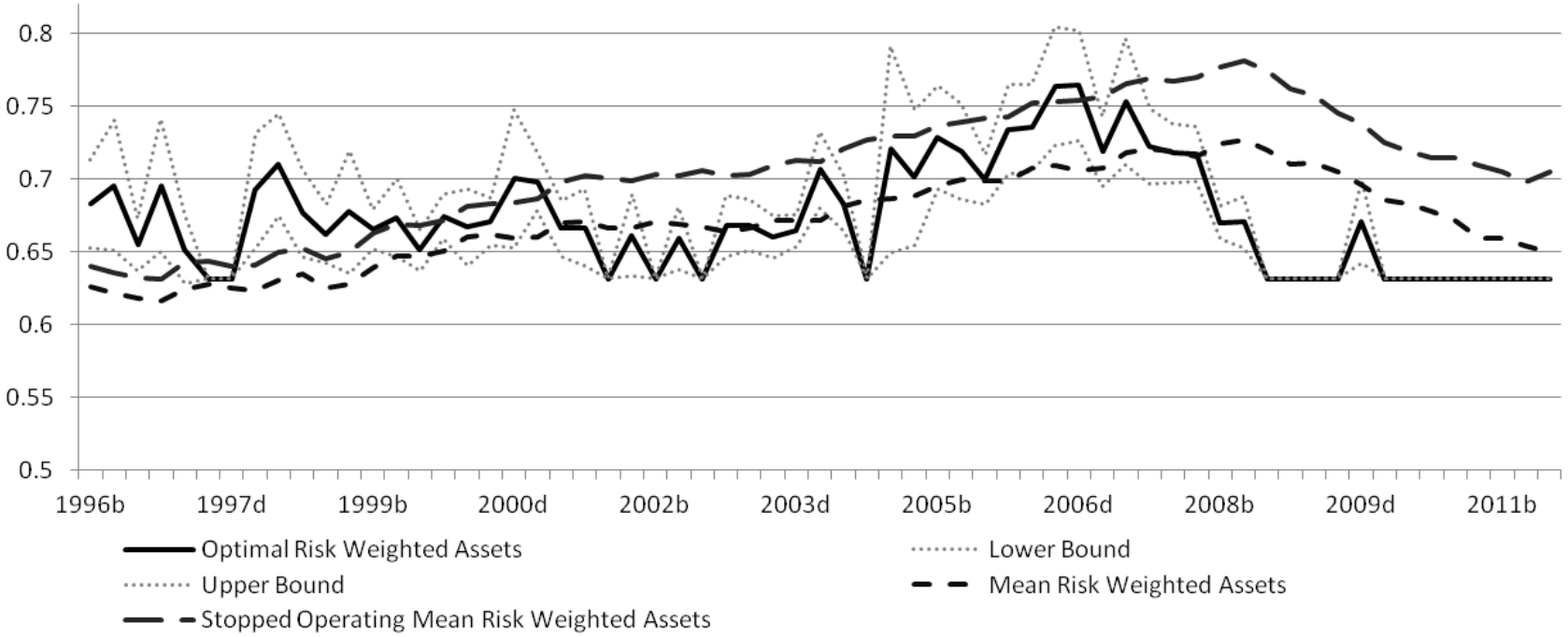
Policy implications

Counter-cyclical bank regulation - capital requirements

Monetary policy and prudential regulation closely linked

European Single Supervisory Mechanism

Stopped operating banks



Sensitivity analysis: specific bank groups

Dependent variable	ROA	ROA	ROA	ROA
ROA $_{t-1}$	0.558***	0.480***	0.483***	0.494***
	(20.031)	(36.105)	(23.219)	(57.114)
Risk-weighted assets $_{t-1}$	0.026	0.038***	0.045***	0.021***
	(1.494)	(9.249)	(8.238)	(4.215)
Risk-weighted assets^2 $_{t-1}$	-0.020	-0.027***	-0.031***	-0.015***
	(-1.597)	(-8.947)	(-8.088)	(-4.036)
Bank size $_{t-1}$	0.000	0.001***	0.002***	0.000*
	(1.254)	(10.589)	(7.659)	(1.714)
Capital $_{t-1}$	0.009	-0.015***	-0.009***	-0.002
	(1.215)	(-11.176)	(-4.901)	(-0.894)
Liquidity $_{t-1}$	-0.004**	-0.002***	-0.002**	-0.005***
	(-2.054)	(-3.683)	(-2.459)	(-5.415)
Non-interest income $_{t-1}$	0.008***	0.008***	0.014***	0.005***
	(4.193)	(7.196)	(7.207)	(8.533)
Problem loans $_{t-1}$	-0.060***	-0.070***	-0.059***	-0.066***
	(-6.195)	(-22.872)	(-11.863)	(-18.716)
Provisions $_{t-1}$	-0.001	0.012	0.027**	-0.119***
	(-0.038)	(1.190)	(2.262)	(-12.579)
Constant	-0.010	-0.015***	-0.012***	-0.004**
	(-1.639)	(-10.637)	(-6.810)	(-2.147)
Optimal point	**0.640*** **	**0.714*** **	**0.710*** **	**0.680*** **
Observations	55,345	279,334	139,143	138,854
R-square (overall)	0.441	0.375	0.352	0.461

Sensitivity analysis: different time frames

Dependent variable	ROA	ROA	ROA	ROA	ROA
ROA $_{t-1}$	0.378***	0.252**		0.489***	0.507***
	(3.295)	(2.209)		(47.470)	(46.743)
Risk-weighted assets$_{t-1}$	2.523***	0.870***	0.068***		
	(7.406)	(2.586)	(14.197)		
Risk-weighted assets$^2_{t-1}$	-1.837***	-0.610***	-0.047***		
	(-7.423)	(-2.755)	(-13.557)		
Risk-weighted assets $_{t-4}$					0.011***
					(4.256)
Risk-weighted assets^2 $_{t-4}$					-0.009***
					(-4.347)
Σ(Risk-weighted assets $_{t-1\ldots t-3}$)				0.036***	
				(10.288)	
Σ(Risk-weighted assets^2 $_{t-1\ldots t-3}$)				-0.026***	
				(-10.230)	
Bank size $_{t-1}$	-0.002***	-0.008**	0.003***	0.001***	0.000
	(-3.117)	(-2.087)	(17.571)	(11.061)	(1.448)
Capital $_{t-1}$	-0.001	0.024	-0.031***	-0.004**	-0.007***
	(-0.051)	(0.785)	(-16.059)	(-2.390)	(-8.561)
Liquidity $_{t-1}$	0.069***	0.045	-0.004***	-0.002***	-0.001
	(5.652)	(1.469)	(-5.526)	(-5.547)	(-1.499)
Non-interest income $_{t-1}$	0.004	0.048*	0.021***	0.008***	0.003***
	(0.302)	(1.886)	(15.578)	(12.829)	(4.708)
Problem loans $_{t-1}$	-0.073*	-0.108	-0.120***	-0.069***	-0.043***
	(-1.841)	(-1.388)	(-32.148)	(-27.390)	(-17.579)
Provisions $_{t-1}$	0.292***	0.511	-0.040***	-0.012	0.002
	(2.722)	(1.549)	(-2.819)	(-1.468)	(0.380)
Optimal point	**0.686*** **	**0.713*** **	**0.721*** **	**0.687*** **	**0.668*** **

Sensitivity analysis: delinquent loans

Dependent variable	ROA	ROA	ROE
ROA $_{t-1}$	0.932***	0.911***	
	(7.312)	(7.505)	
ROE $_{t-1}$			0.993***
			(7.793)
Deliquent loans $_{t-1}$	0.224*	0.238*	2.609**
	(1.806)	(1.715)	(2.019)
Deliquent loans^2 $_{t-1}$	-6.769*	-7.125*	-90.303**
	(-1.850)	(-1.755)	(-2.008)
Risk-weighted assets $_{t-1}$	-0.060**	-0.059**	-0.385
	(-2.243)	(-2.358)	(-1.592)
Bank size $_{t-1}$	0.011	0.007	0.082
	(0.929)	(0.636)	(0.748)
Capital $_{t-1}$	0.207**	0.183**	2.052**
	(2.563)	(2.302)	(2.474)
Liquidity $_{t-1}$	-0.047	-0.042	-0.336
	(-0.965)	(-0.959)	(-0.715)
Non-interest income $_{t-1}$	-0.004	0.003	-0.250
	(-0.065)	(0.063)	(-0.618)
Problem loans $_{t-1}$	-0.342	-0.315	-3.089
	(-1.590)	(-1.607)	(-1.391)
Provisions $_{t-1}$	-1.076	-0.811	-3.118
	(-0.908)	(-0.736)	(-0.269)
Commercial loans $_{t-1}$		0.005	0.011
		(0.735)	(0.137)
Loans to individuals $_{t-1}$		-0.018	0.014
		(-0.459)	(0.037)
Loans to real estate $_{t-1}$		0.000	0.002
		(0.160)	(0.214)
Optimal point	0.017***	0.017***	0.014***

Optimal based on delinquent loans