Nonlinear Bank Capital Regulation

Maximilian Jager and Karl Schulz

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Discussion by Pab Jotikasthira
SMU - Dallas

Summary

Presents **a unifying framework for bank capital regulation**, and uses the perturbation approach with a few calibrated sufficient statistics to perform "quantitative" positive and normative analyses (e.g., assessing different policy proposals).

Entrepreneurs: $\mathcal{V}_\theta^E = \max_{d_\theta} U_\theta^E(d_\theta; k_\theta, z_\theta) \quad \text{s.t.} \quad \mathcal{C}_\theta^E(d_\theta; k_\theta, z_\theta) \leq 0,$

Households (depositors): $\mathcal{V}^H = \max_{c} U^H(c; x) \quad \text{s.t.} \quad \mathcal{C}^H(c; x) \leq 0.$

Bank:

$$\mathcal{V}^B = \max_{x,p} U^B(x,p) \quad \text{s.t.} \quad \mathcal{P}(p_\theta, k_\theta, z_\theta; d_\theta, \theta) = 0,\ \forall\theta, \quad \mathcal{C}(x,p;c,d) \leq 0, \quad \boxed{\mathcal{R}(x,p) \leq 0.}$$

where $\mathcal{R}(k, \mathcal{E}, p) \equiv \int_\Theta \boxed{\omega(p_\theta)} k_\theta \, d\theta - \mathcal{E} / \boxed{\Omega} \leq 0$

Nonlinear capital regulation (nonlinear function of default risk)

Capital adequacy ratio, e.g., 8%

Summary –cont'd

In equilibrium (all agents respond optimally to others), behavioral responses can be characterized by the following sufficient statistics:

$$\zeta_\theta^{k,\omega} \equiv \left.\frac{\partial \log k_\theta}{\partial\, \omega(p_\theta)}\right|_{\bar{p}}, \qquad \zeta_\theta^{k,\omega'} \equiv \left.\frac{\partial \log k_\theta}{\partial\, \omega'(p_\theta)}\right|_{\bar{p}}, \qquad \zeta_\theta^{k,p} \equiv \frac{\partial \log k_\theta}{\partial \log \bar{p}_\theta}, \qquad \varepsilon_\theta^{p,k} \equiv \frac{d \log p_\theta}{d \log k_\theta}.$$

Also needs a few marginal welfare externalities to be able to perform normative analyses:

$$\chi^H \equiv -\frac{1}{\mu}\frac{d\mathcal{V}^H}{d\mathcal{E}} \qquad \xi_\theta^H \equiv -\frac{1}{\mu}\frac{d\mathcal{V}^H}{dk_\theta} \qquad \text{and} \qquad \xi_\theta^E \equiv -\frac{1}{\mu}\frac{d\mathcal{V}_\theta^E}{dk_\theta}, \ \forall\theta.$$

These statistics are then estimated using detailed German credit registry data (where banks provide probability of default estimate for each loan).

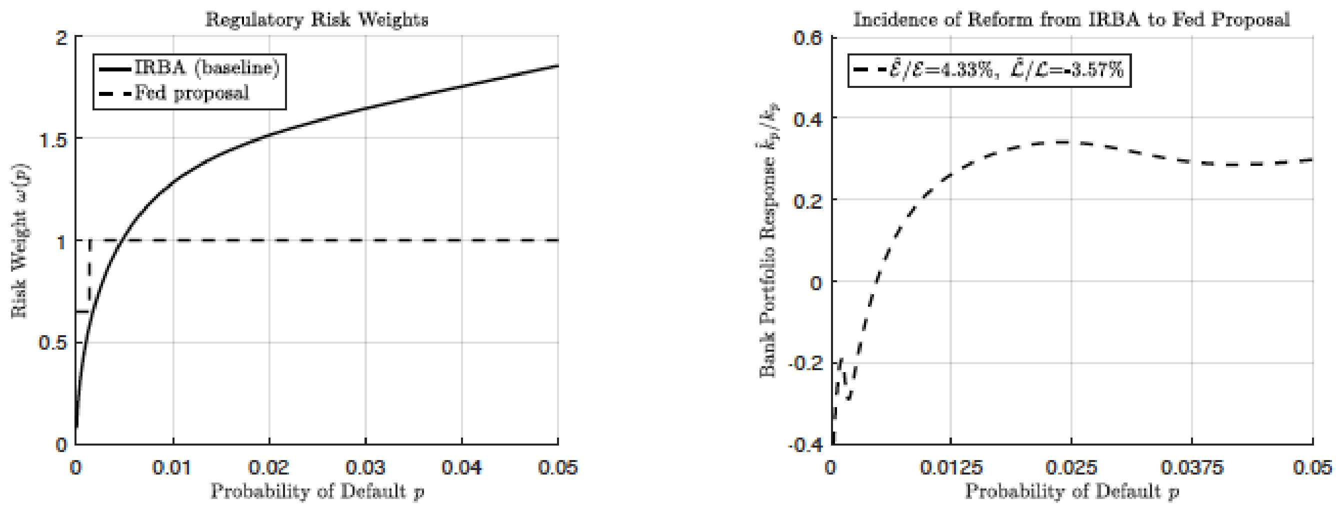
	Homogeneous (1)	Risk Category 1 (2)	Risk Category 2 (3)	Risk Category 3 (4)	Risk Category 4 (5)
$\log(\widehat{credit}_{i,t-1})$	0.019***	0.019***	0.011***	0.023***	–0.024***
	(0.002)	(0.004)	(0.002)	(0.002)	(0.004)
Firm FE	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y
Obs.	280,171	7,334	30,392	213,491	26,528
R^2	0.693	0.733	0.536	0.632	0.635

Table 4: Estimated credit-risk elasticities (German credit registry).

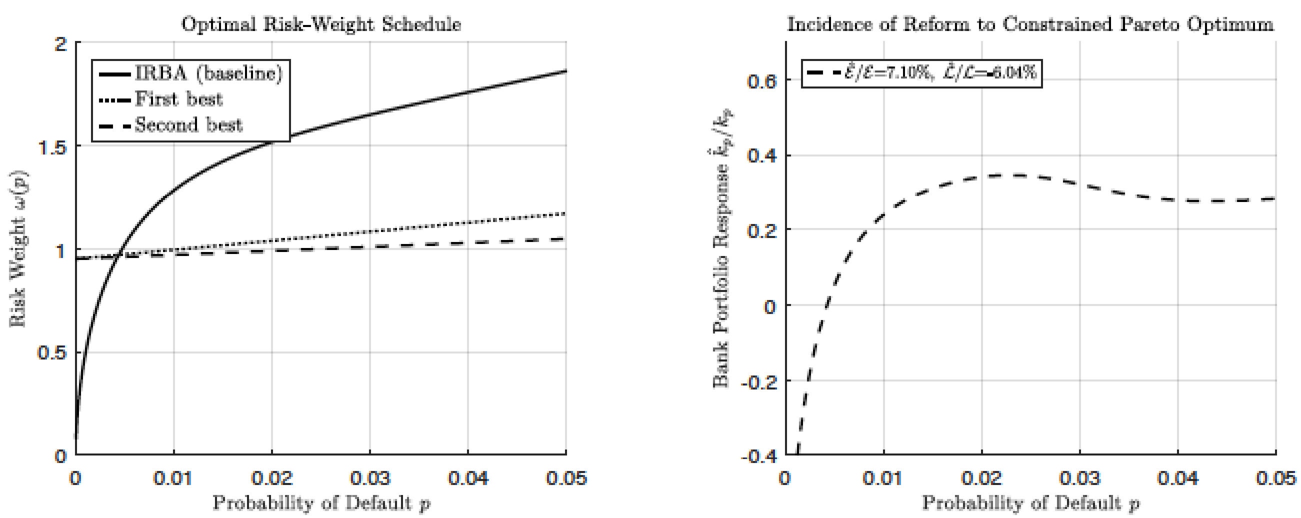
	Homogeneous (1)	Risk Category 1 (2)	Risk Category 2 (3)	Risk Category 3 (4)	Risk Category 4 (5)
$\log(p_{i,b,t-1})$	–0.063***	–0.006	0.045	–0.049**	–0.129***
	(0.017)	(0.091)	(0.050)	(0.018)	(0.027)
$\omega_{i,b,t-1}$	–0.759***	–1.289***	–1.430***	–0.732***	–0.271***
	(0.124)	(0.370)	(0.280)	(0.121)	(0.052)
Bank FE	Y	Y	Y	Y	Y
Borrower x Time FE	Y	Y	Y	Y	Y
Obs.	1,616,772	82,962	213,888	909,427	62,196
R^2	0.677	0.605	0.646	0.692	0.719

Table 5: Estimated credit-supply elasticities (German credit registry).

We can then assess policy – e.g., the Fed's Basel Endgame



And, we can obtain "optimal" risk weights:



My Thoughts

Ambitious paper addressing important question!

- Circumventing complex theory and specific designs using sufficient statistics.
- Flexible and easy to calibrate, permitting positive and normative analyses around the observed equilibrium.

Generality comes at a cost …

- Silent on exact economic mechanisms and decisions (price, in particular, is missing).
- Needs assumptions anyway when calibrate.
- Results are local and may not be generalized for complex, nonlinear models.

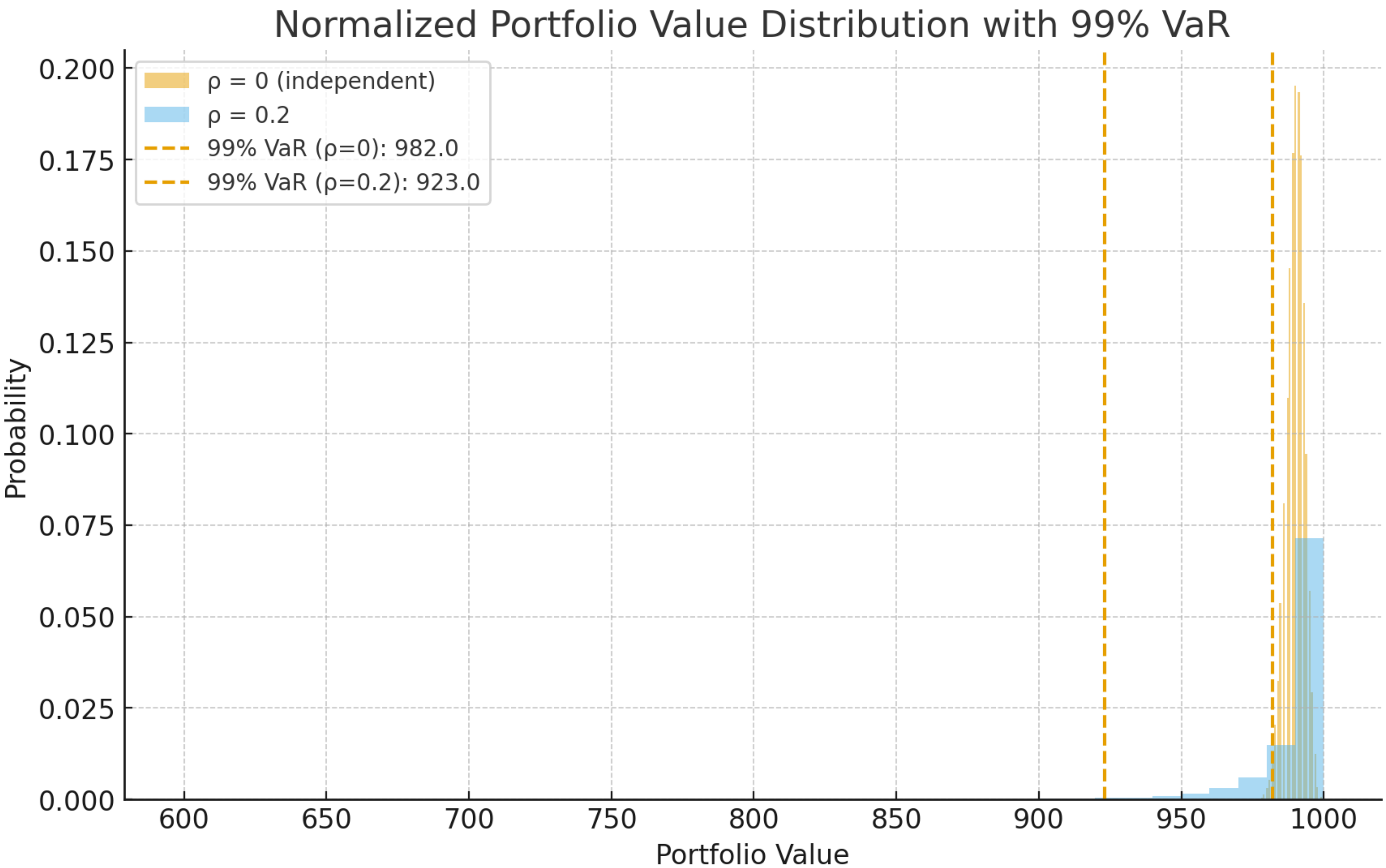
1. Economic Mechanisms

- Silent.
  - Signs of sufficient statistic estimates may be consistent with some mechanisms but not others.
  - No system to look across all estimates to pin down the exact model.
  - Not transparent on missing ingredients and simplifying assumptions.
- **Cross-loan spillovers and correlations?**
  - Only see substitution but it's not the same.
  - Not clear why the MRS are not part of sufficient statistics and not estimated ….

$$\frac{\hat{k}_\theta}{k_\theta} = \zeta_\theta^{k,\omega}\hat{\omega}(p_\theta) + \zeta_\theta^{k,\omega'}\hat{\omega}'(p_\theta) + \varepsilon_\theta^{k,p}\frac{\hat{p}_\theta}{p_\theta} - \frac{\partial MRS_\theta}{\partial \mathcal{E}}\frac{\hat{\mathcal{E}}}{k_\theta} - \int_{\theta'}\left(\frac{\partial MRS_\theta}{\partial k_{\theta'}}\frac{\hat{k}_{\theta'}}{k_\theta} + \frac{\partial MRS_\theta}{\partial \overline{p}_{\theta'}}\frac{\hat{p}_{\theta'}}{k_\theta}\right)d\theta'.$$

1. Economic Mechanisms –cont'd

- **Risk pricing** and capital adequacy must be used together.
  - The authors wonder why the sensitivity of credit to risk is weak, and mention price adjustments as perhaps a reason.
  - Without frictions, **price NOT quantity captures the expected default loss** (plus risk premium, etc.)
  - **Capital captures the "unexpected" loss (or, VaR – EL)**. Default probability is actually not a sufficient statistic for unexpected losses.
  - Price is part of many canonical models, and is also observable.



Normalized Portfolio Value Distribution with 99% VaR
ρ = 0 (independent)
ρ = 0.2
99% VaR (ρ=0): 982.0
99% VaR (ρ=0.2): 923.0
Probability
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
600
650
700
750
800
850
900
950
1000
Portfolio Value

2. Calibration Problems

- Adhoc assumptions are made in the calibration, diminishing generality.
- For example, profits = utility. Where is risk? Firms maximize one-period profits?
- Externalities on households are just the losses in bailout?

of the bank $\Pi^B(\cdot, \upsilon)$. Letting $\kappa_{\mathcal{T}} = 25\%$ denote the deadweight cost of deposit insurance, the total fiscal externality is

$$-(1+\kappa_{\mathcal{T}})\mathcal{T}, \quad \text{where} \quad \mathcal{T} \equiv \max\{0, \mathcal{D} - \Pi^B(\cdot, \upsilon)\}.$$

The state-contingent going concern value of the bank consists of total loan repayments (loan rate $r = 4.68\%$; see Corbae and D'Erasmo (2021)), recovered loans in default (recovery rate $\phi = 0.6030$; see Corbae and D'Erasmo (2021)), and the post-liquidation value of the loan portfolio (depreciation rate $\iota = 0.1965$; see Corbae and D'Erasmo (2021)):

$$\Pi^B(\cdot, \upsilon) = \int_\Theta \left[\upsilon(1+r)(1-p_\theta) + (1-\phi)p_\theta - \iota\right] k_\theta \, d\theta.$$

- Even the proper estimation of sensitivities is not coherent.

2. Calibration Problems –cont'd

$$\underline{\log(credit_{i,b,t})} = \gamma(BankLevy_{b,t-1} \times LevyIntroduction_t) + p_{i,b,t-1} + \beta X_{b,t-1} + \underline{\mu_{i,t} + \mu_b + v_{i,t}}$$

Should have bank-firm fixed effects (b,i)

and

$$p_{i,t} = \boxed{\zeta_p^{p,k}} \log(\widehat{credit_{i,t-1}}) + \beta X_{i,t-1} + \mu_i + \mu_t + u_{i,t}.$$

Should include all controls from above especially past default probability

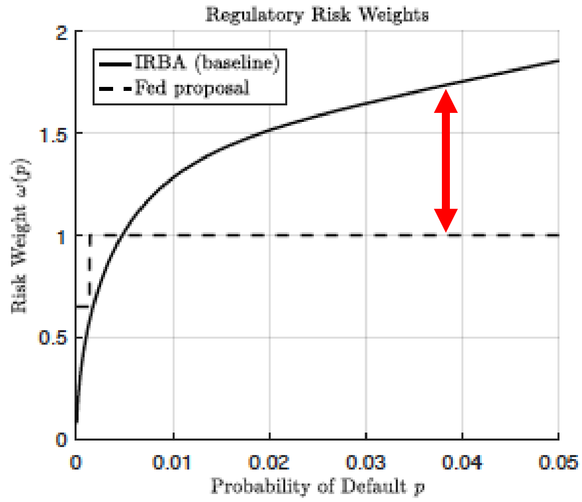
Why not the same equation?

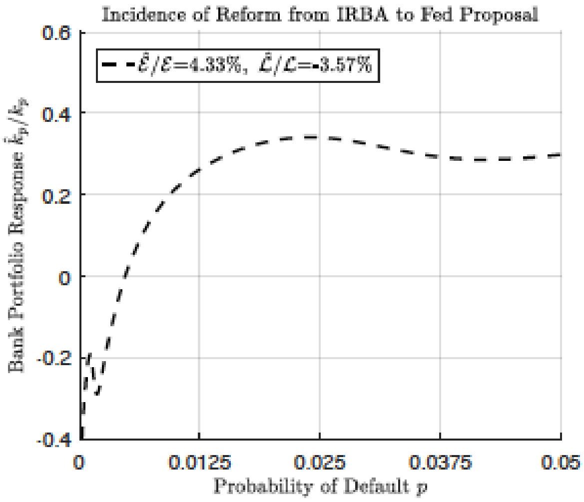
$$\underline{\log(credit_{b,i,t})} = \boxed{\varepsilon_p^{k,p}} \log(p_{i,b,t-1}) + \boxed{\zeta_p^{k,\omega}} \omega_{i,b,t-1} + X_{b,t-1} + \mu_b + \mu_{i,t} + u_{i,t}$$

Where is the slope effect (w')? How to proxy for it?

3. Local vs. Global Assessment

- Sensitivity estimates are local, but some of the assessments look at large changes.





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To Conclude …

Ambitious paper addressing important question!

- Circumventing complex theory and specific designs using sufficient statistics from a general model.
- Interesting policy-relevant results.

My two cents …

- Bring in price and cross-loan correlations. Discuss the sufficient statistic estimates, taken together – consistent with which models?
- Motivate assumptions used in the calibration, and perform sensitivity analysis. Can we really take the quantitative exercise seriously? Any standard error bound?
- Be careful extrapolating beyond the local estimates.