Efficient or systemic banks: Can regulation strike a deal?

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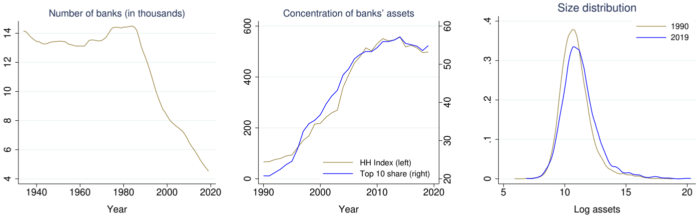
Evolution of the US banking sector ...



- 1980s and before: A large number of banks
- 1990s and 2000s: Branching deregulation and consolidation
  - ... led to fewer and bigger banks
- 2008: Recognition of too-big-to-fail risks
  - ... led to reforms that create disincentives to becoming large

… reflects an efficiency v.s. financial-stability trade-off

- Large banks tend to be more efficient …
  - Theory
    - Spread fixed costs more widely (Humphrey, 1990)
    - More diversified (Diamond, 1984)
    - Operational synergies (Kanatas and Qi, 2003)
    - Better screening, internal capital markets (Stein, 1997, 2002)
  - Empirics
    - Rise of larger banks is a testimony to the benefits of scale
    - Cost efficiency improves with size (Wong et al, 2008) Data
    - Even after considering risk-taking (Hughes and Mester, 2013)

- … but large bank failures are socially more costly
  - While estimates vary, Lehman failure & GFC wiped 4% of global GDP
  - Aversion to close larger insolvent banks (Kang et al, 2015)
    - Size can matter due to implicit guarantees (Davila & Walther, 2020) and/or complexity (Caballero & Simsek, 2013)

This paper

Research question

- How should banks be organized – many small or few large?

Approach

- Stylized model to formalise the efficiency versus financial-stability trade-off
  - Note: abstract from market-power, another key element of the trade-off
- Embed heterogeneous banks in a canonical macro framework
  - Endogenous size distribution
  - Endogenous default
  - Calibrate to micro-data on US banks
- Analysis
  - Use capital regulation as tool to influence banking dynamics
  - Characterise optimal size-dependent regulation

Main takeaways

- Tighter regulation has opposing effects on bank dynamics
  - Lower leverage (i.e. banks grow more slowly)
  - Lower failure rate (i.e. banks survive longer)
- Regulation that equates leverage, riskiness, or expected default losses (as in case of the Basel III G-SIB framework) across banks is sub-optimal ...
  - ... it does not internalize that both efficiency and financial-stability risks are size-dependent
- Optimal regulation should be flexibly bank size-dependent
  - Calibration suggests tighter for larger banks
- Optimal distribution features more middle-sized banks

Related Literature

- **Banking dynamics / bank heterogeneity:** Competition for loans (Boyd and De Nicolo, 2005), imperfect competition among banks (Corbae and D' Erasmo, 2021; Jamilov, 2021), impact of risk-based capital and leverage requirements on heterogeneous banks (Muller, 2022) etc.

- **Industry dynamics more generally:** Productivity shocks in Hopenhayn (1992), Learning in Jovanovic (1982); Cost shocks in Asplund and Nocke (2006); Borrowing constraint due to limited enforcement and limited liability: Albuquerque and Hopenhayn (2004), Clementi and Hopenhayn (2006), Cooley and Quadrini (2006), etc.

- **Macro-finance models:** Gertler and Karadi (2010), Gertler and Kiyotaki (2010), Adrian & Boyarchenko (2012), etc.

- **Capital regulation:** Heuvel (2008), Begenau (2015), Nguyen (2014), Corbae and D' Erasmo (2014), Covas and Driscoll (2014), Christiano and Ikeda (2013), Passmore and Hafften (2019), etc.

Static Model

How to distribute capital across banks

- Planner must decide the number of banks M to set up using a given capital endowment K
- Bank with capital k_i raises deposit funding f_i at rate R
  - Bank is subject to capital regulation: $k_i/(k_i + f_i) \geq \chi$
- Invest in $s_i = k_i + f_i$ projects
  - Project returns distributed as $\mathbb{N}(\mu, \sigma)$
  - Total return embeds diversification: $z_i \sim \mathbb{N}(\mu s_i, \sigma^2 s_i^d)$
    - Perfectly positively correlated: $d = 2$
    - Not correlated: $d = 1$
    - Negatively correlated: $d < 1$
- Probability of failure: $p_i = Pr(z_i \leq R(s_i - k_i))$ is lower if capital is higher (despite same leverage)
- Large bank failures are more costly: $\Delta''(s_i) > 0$

How to distribute capital across banks

Planner maximises expected cash flow such that $\sum_{i=1}^{M} k_i = K$:

$$\max_M \underbrace{\sum_{i=1}^{M} \Big(\mu s_i - R(s_i - k_i)\Big)}_{\text{Expected Return}} - \underbrace{\sum_{m=0}^{M} \Delta(ms) Binomial(m; M; p(M))}_{\text{Expected Loss}}$$

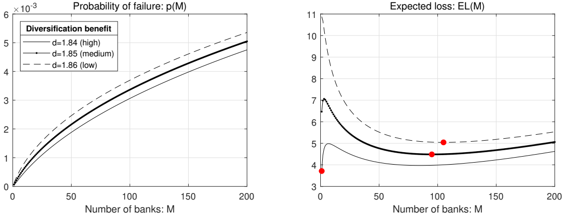


Figura: Optimal number of banks in red, while assuming that projects across banks, and thus bank failures, are not correlated. Parameter values are as follows: $K = 100, R = 1.04, \chi = 10\%, \mu = 1.05, \sigma = 0.05, \Delta(s) = 0.1s^2$.

Dynamic Model

Setup

- Time is discrete, horizon is infinite
- No aggregate uncertainty; only bank-level shocks
- Entities:
  - Household:
    - Representative worker
    - Unit mass of atomistic bankers
  - Banks
  - Government
  - Regulator

Household

Maximizes utility under perfect consumption insurance:

$$\max_{C_t, D_t} \quad \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(C_t)$$

$$\text{s.t.} \qquad C_t + D_t = W_t + E_t + R_{t-1} D_{t-1} - T_t$$

- C: consumption
- D: deposits (risk-free)
- W: wage income
- E: dividend income
- R: interest rate
- T: lumpsum tax

Bankers

$$V(n) = \max_{s,d,e} \quad \left(H(e) + \beta \int_{\psi^c} V(n') dF_s(\psi') \right)$$

$$\text{where } \; n' = \psi' s - Rd; \qquad n' \leq \tau \implies \psi^c = \frac{Rd + \tau}{s};$$

$$s.t. \quad \underbrace{n + d = s + e + td}_{\text{Cash-flow constraint}}; \qquad \underbrace{\chi(n) \leq \frac{n - e}{s};}_{\text{Capital constraint}} \qquad \underbrace{0 \leq e;}_{\text{Limited liability}} \quad .$$

- H: concave preference over dividends
- e: dividends; d: deposits
- s: assets with return ψ'
- $\psi \sim N(\theta(s), \sigma(s))$ embeds diversification benefits via s
  - banks with more post-dividend capital fail less often
- τ: failure threshold
- t: deposit insurance premium rate

Government

- Deposit insurance scheme covers shortfall in liabilities of failing banks
- Provide (random) seed-funding $n^e \sim G$ to entrants
- Runs a balanced budget each period via lumpsum tax on (or rebate to) the household
- Two key assumptions
  - Resolving a failed bank is costlier for bigger banks
  - Mis-priced insurance $\rightarrow$ banks over-borrow $\rightarrow$ rationalise capital regulation

Timeline

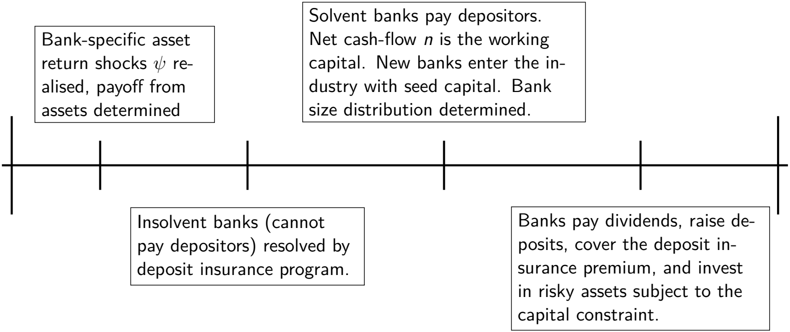


Figura: Intra-period sequence of events

Stationary size-distribution of banks ...

... computed as the fixed point of the distribution evolution:

$$\mu(N) = \underbrace{M \int_{\tau}^{N} dG(n^e)}_{\textit{Entrants}} +$$

$$\underbrace{\int \left(\int_{\underline{\psi}}^{\overline{\psi}} \mathbb{1}\Big[\tau \leq \psi s(n) - Rd(n) \leq N\Big] dF_s(\psi) \right) d\mu_{-1}(n)}_{\text{Transition of incumbents net of exits}}$$

- M: mass of entrants (same as mass of failures in steady state)
- μ: cumulative distribution function for bank capital

Main parameters

Parameters	Symbol	Value
Discount factor	β	0.99
Resolution loss rate	Δ	20% to 24%
Benchmark regulation	χ	4.5%
Insurance premium rate	t	20 bps
Distribution of asset returns	θ_ψ	$1.02 - 0.0051/(1+s)$
Std deviation of asset returns	σ_ψ	$0.0195 + 0.0055/(1+s)$
Entrant distribution (lognormal)	$G(\theta_G, \sigma_G)$	$165, 7.49$
Default threshold	τ	7.01
Moments	**Data**	**Model**
Mean of ROA	0.776%	0.803%
S.d. of ROA	0.914%	2.208%
Mean of ROA, larger versus smaller banks	23.8 bps	27.5 bps
S.d. of ROA, larger versus smaller banks	-25.5 bps	-29.7 bps
Dividend payout to capital ratio	4.996%	3.603%
Exit rate	3.966%	2.461%
Ratio to smallest to median bank	1.453%	1.003%
KS statistic	0.0	0.0515
Power-law exponent	-0.7715	-0.7186

- Bank value and policy functions show
- Definition of Stationary Competitive Equilibrium show
- Variation in bank efficiency show

Steady-state bank capital distribution

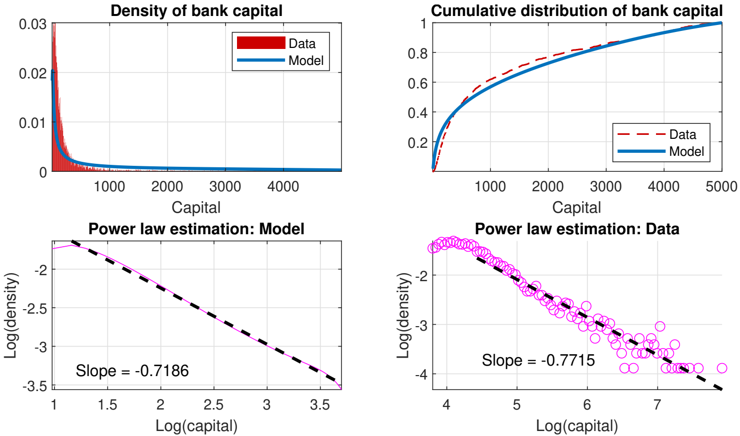
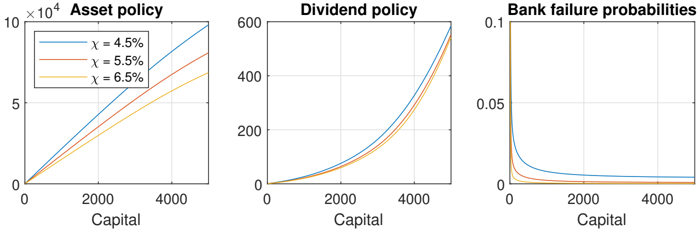


Figura: A comparison of model generated distribution of bank capital with that observed in the data.

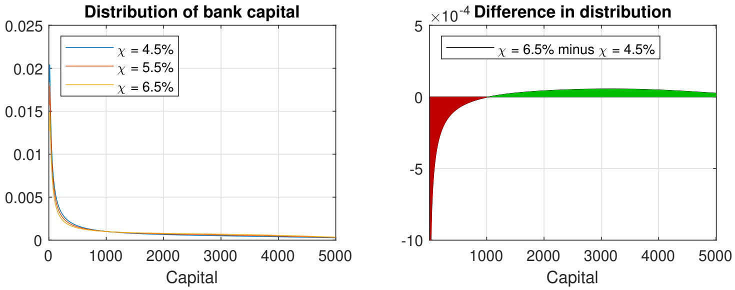
Uniform capital regulation
(i.e. independent of bank characteristics)

Effect of regulation: positive analysis



- Tighter regulation reduces bank lending and dividends (capital preservation) ...
- ... but also reduces the bank failure probability

Effect of regulation: positive analysis



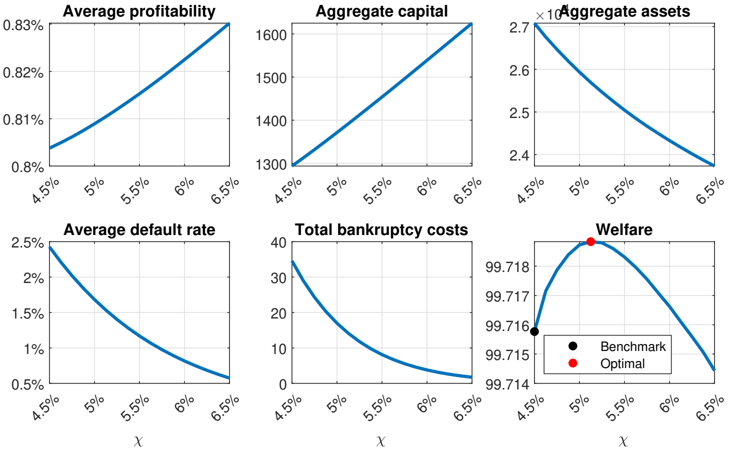
- Tighter regulation reduces growth-rate, but improves survival
- Induces more middle-sized banks

Effect of regulation: normative analysis

Benevolent regulator maximises lifetime utility of the representative household (depositors and bankers):

$$\max_{\chi} \frac{u(C)}{(1-\beta)}$$

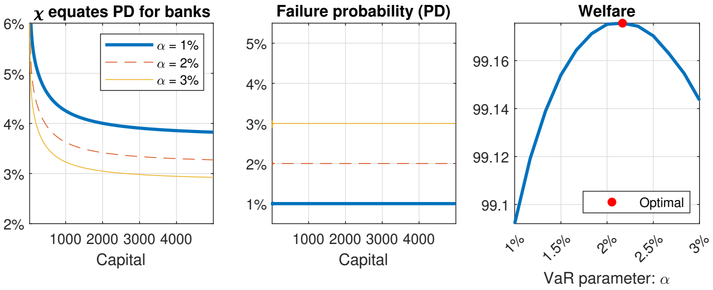
Effect of regulation: normative analysis



- Aggregate capital increases (more retained earnings)
- Welfare gain in consumption equivalent terms is 1.09%
- Role of industry dynamics and loss rate show

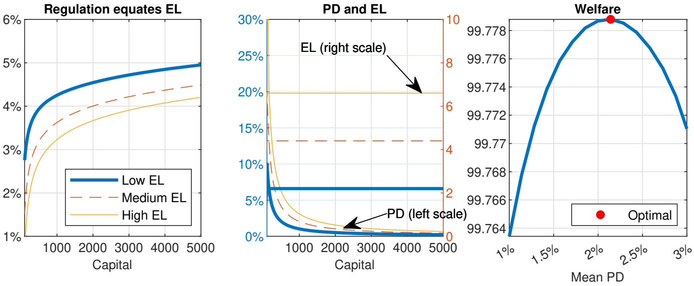
Bank-specific capital regulation: A tale of three regimes

Regime I: Equating probability of default (PD) across banks



- In order to equate PD across banks, χ is higher for the smaller banks since they are riskier
- Comparable to risk-weighted capital requirements, but is sub-optimal:
  - Expected loss (which matters for welfare) also depends on bank size

Regime II: Equating EL = PD x EAD x LGD across banks

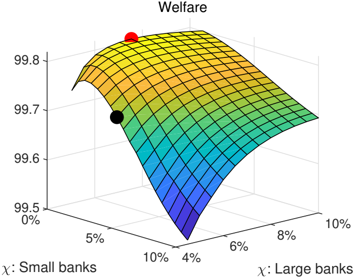


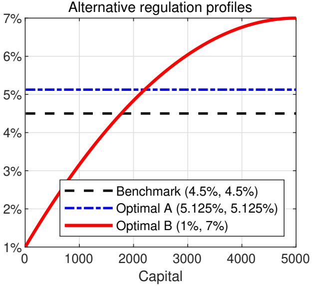
- In order to equate EL across banks, χ is higher for bigger banks since EAD is greater for bigger banks ...
  - ... and leads to higher EL despite lower PD

- Comparable to the G-SIB framework, but still sub-optimal:
  - Bank efficiency also varies with size

Regime III: Flexible bank-specific regulation

$$\chi(n) = \chi_0 + \chi_1 n + \chi_2 n^2 \quad \text{(asymptotes for large banks)}$$





- Optimal requirement close to 7% for big banks and 1% for small banks
- Similar in spirit to regime II (2.5% to 4.5%), but *steeper*

Extensions

- Endogenous return on assets ‣ Show
- Endogenous mass of banks ‣ Show

Conclusion

- Should regulation encourage or discourage large banks?
  - Trade-off: scale economies versus financial stability risks

- Develop a tractable model to study this trade-off
  - Endogenous size distribution that responds to regulation
  - Explicit role of regulation enables normative analysis

- Main takeaways
  - Regulation **shapes** bank size-distribution
  - Size-dependent regulation is needed to address a trade-off that is size-sensitive
    - Focusing only on how risks vary with size while ...
    - ... ignoring how efficiency depends on size is sub-optimal
  - Optimal regulation is **tighter** for larger banks ...
  - ... and induces more **middle-sized** banks

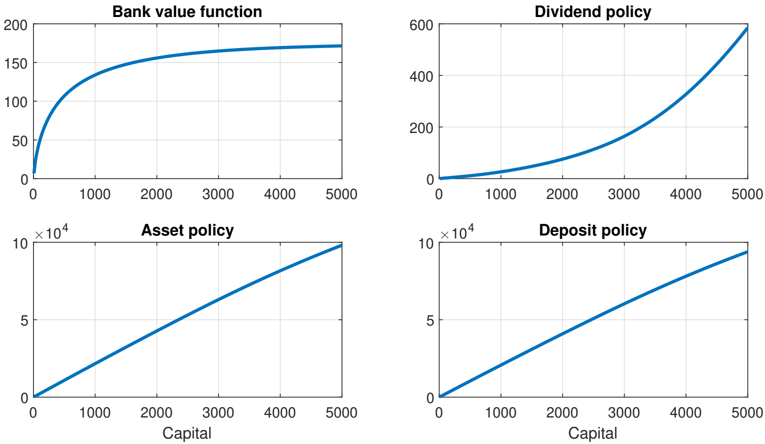
Thank You

Appendix

Bank size and efficiency

Notes: US commercial and savings banks. Pooled annual data from 2000 to 2019. Source: SNL. Back

Value and policy functions



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Stationary competitive equilibrium

1. $V(n), s(n), d(n)$ and $e(n)$ solve the bank's problem given R:
2. Deposit market clears at interest rate R

$$\int d(n) d\mu(n) = D$$

3. Goods market clears

$$Y = \int \int_{\psi_c} \psi' s(n) dF_s(\psi') d\mu(n) = C + S + O - W$$

$$S = \int s(n) d\mu(n); \; O = \int \int^{\psi_c} \Delta(\psi' s(n)) dF_s(\psi') d\mu(n)$$

4. The distribution of bank capital is the unique fixed point of the distribution evolution operator T given entrant mass M:

$$\mu = T(\mu, M);$$

5. Government runs balanced budget: T + tD = start-up funding + liabilities of failed banks

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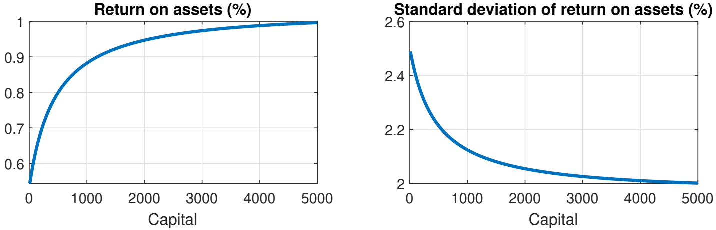
Variation in bank efficiency



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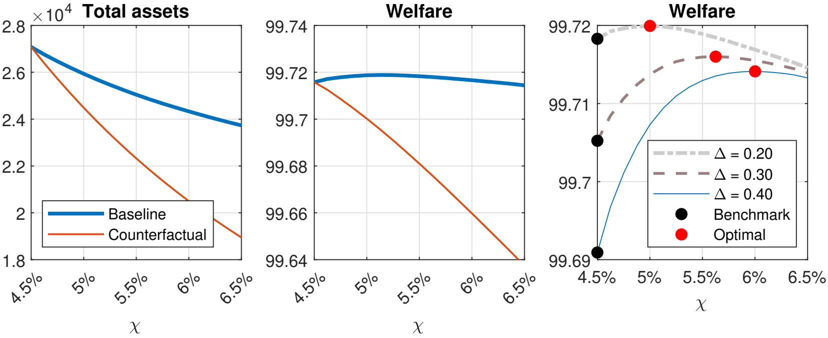
Role of distribution and bankruptcy costs



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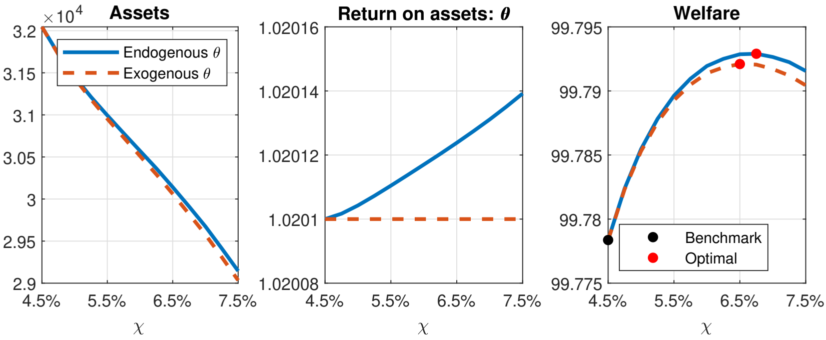
Endogenous return on assets



Note: The size-dependence of asset returns is switched off in this extension.

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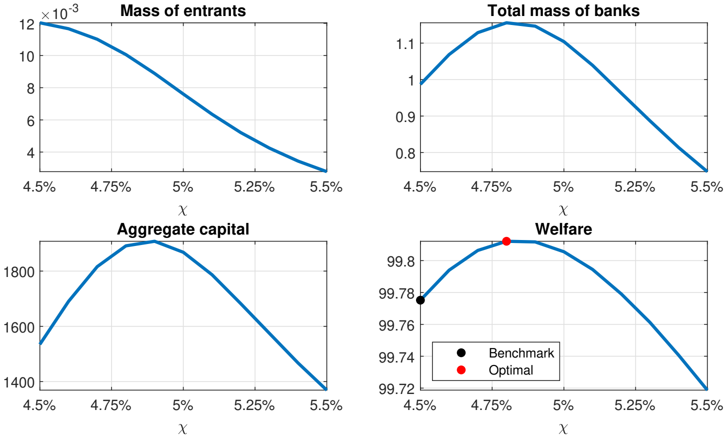
Endogenous mass of banks



Note: Asset returns are also endogenous in this extension.

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