The Effects of Capital Requirements on Good and Bad Risk-Taking

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Introduction

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  - Lower supply of socially-valuable liquidity [not in this paper]
  - Reduction of socially-valuable risk taking of firms [this paper]
Approach

▶ Our argument:

Financial regulation affects the risk-taking capacity of the private sector.
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- Take as given full deposit insurance; motivation outside the model
  (Begenau, 2016; Davydiuk, 2017; Dempsey, 2017; ...)

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  ▶ Avoid runs
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Avoid runs

Implies the usual benefit of tighter capital requirements: reduce excessive risk-taking by banks.
Sketch of the mechanism

- Firms use deposits to self-insure idiosyncratic shocks.
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- Firms use deposits to self-insure idiosyncratic shocks.
- Tighter capital requirements reduce the return on deposits.
- A lower return on deposits reduces the ability to self-insure and thus the (good) risk-taking by firms.
- We balance this cost of capital requirements against a deadweight loss from bank default, i.e. “bad” risk-taking.
Environment

- Discrete time, infinite horizon model
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- Discrete time, infinite horizon model
- Single good
  - Consumed
  - Invested
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- Discrete time, infinite horizon model

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- Players
  - Firms (run by managers, subject to an agency friction)
  - Banks (∼ technology)
  - Households (own banks and firms, provide labor)
  - Government (provides deposit insurance)
Firms

Maximize

\[ V_t^m (x_t^i) = \max_{c_t^i, d_t^i, l_t^i} \theta \log c_t^i + \beta^m E_t \left\{ (1 - \alpha) V_{t+1}^m (x_{t+1}^i) + \alpha V^{exit} (x_{t+1}^i) \right\} \]
Firms

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subject to

\[ c_t^i + d_t^i \leq x_t^i \]

\[ x_{t+1}^i = \left( 1 - \tau_{t+1} \right) \left[ (z_{t+1}^i - w_t) l_t^i + R_t^d d_t^i \right] \]

\[ x_{t+1}^i \in \{ 0, \bar{z} \} \]: idiosyncratic productivity shock

\[ w_t \]: wage (cannot be contingent on \( z_{t+1}^i \))

\[ l_t \]: labor
Firms

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\[ V^m_t (x^i_t) = \max_{c^i_t, d^i_t, l^i_t} \theta \log c^i_t + \beta^m E_t \left\{ (1 - \alpha) V^m_{t+1} (x^i_{t+1}) + \alpha V^{\text{exit}} (x^i_{t+1}) \right\} \]

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Project

\[ z^i_{t+1} \in \{0, \bar{z}\}: \text{idiosyncratic productivity shock} \]

\[ w_t: \text{wage (cannot be contingent on } z^i_{t+1}) \]

\[ l^i_t: \text{ labor} \]
Firms (aggregation)

▶ Firms are owned by households.
▶ Each period with probability $\alpha$ the firm exits and pays a fraction $\kappa$ of its net worth to the manager and $1 - \kappa$ to households.
▶ Households start a measure $\alpha$ of new firms with start-up funds proportional to aggregate net worth of all firms.
▶ We take the limit as $\theta, \kappa, \beta \to 0$ and $m \to 1$.
▶ Ensures that managers' first-order conditions hold even as they consume a vanishing fraction of output.
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Banks

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- Aggregate capital is fixed at $\bar{k}$, price $q_t$. 

\[ \text{subject to } q_t k_t = n_t + d_t \quad \text{(budget constraint)} \]

\[ \text{equity assets } = n_t q_t k_t \geq \zeta \quad \text{(capital requirement)} \]

$\zeta$: capital requirement chosen by the government

$\epsilon_{t+1}$: idiosyncratic shocks to banks' productivity

$E_t \{ \epsilon_{t+1} \} = 1.$
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- Aggregate capital is fixed at $\bar{k}$, price $q_t$.
- Created at time $t$ with equity $n_t$, liquidated at $t + 1$

$$\max_{k_t, d_t} E_t \int \left\{ \varepsilon k_t (A_{t+1} + q_{t+1}) - R_t d_t \right\}^+ dF_{t+1}(\varepsilon)$$
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$$\max_{k_t, d_t} E_t \int \left\{ \varepsilon k_t (A_{t+1} + q_{t+1}) - R_t^d d_t \right\}^+ dF_{t+1} (\varepsilon)$$

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Households

- Own the banks and firms, and supply labor to firms.
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- Maximize

\[
V_t^h(a_t) = \max_{c_t, l_t, n_t} \quad c_t - \nu_1 \frac{l_t}{1 + \frac{1}{\nu_2}} + \beta E_t V_{t+1}^h(a_{t+1})
\]

- subject to

\[
\begin{align*}
    c_t + n_t & \leq a_t + w_t l_t \\
    a_{t+1} & = \underbrace{n_t R_{t+1}^E (1 - \tau_{t+1})}_{\text{after-tax return on bank equity}} + \underbrace{\pi_{t+1}}_{\text{profits of exiting firms}}
\end{align*}
\]
Households

- Own the banks and firms, and supply labor to firms.
- Maximize

\[ V_t^h(a_t) = \max_{c_t,l_t,n_t} c_t - \nu_1 \frac{1}{l_t^{1+\frac{1}{\nu_2}}} + \beta E_t V_{t+1}^h(a_{t+1}) \]

- subject to

\[ c_t + n_t \leq a_t + w_t l_t \]

\[ a_{t+1} = n_t R_{t+1}^E (1 - \tau_{t+1}) + \pi_{t+1} \]

after-tax return on bank equity

profits of exiting firms

- Labor supply curve:

\[ w_t = \nu_1 (l_t)^{1/\nu_2} \]
Government

- Collect taxes $T_{t+1}$ to pay for deposit insurance disbursement
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- A bank defaults if $\varepsilon_{t+1} < \varepsilon_{t+1}$, so

\[
T_{t+1} = \int_{-\infty}^{\varepsilon_{t+1}} \left( R^d_t \, dt \underbrace{ - \varepsilon k_t (A_{t+1} + q_{t+1})}_{\text{owed to depositors} \, \text{collected from banks}} \right) \, dF_{t+1}(\varepsilon) \\
+ \frac{\lambda}{2} \left[ \int_{-\infty}^{\varepsilon_{t+1}} \left( R^d_t - \varepsilon k_t (A_{t+1} + q_{t+1}) \right) \, dF_{t+1}(\varepsilon) \right] ^2
\]

deadweight loss

Deadweight loss: $\lambda > 0$ to capture negative effects of banks' bad risk-taking

$\lambda = 0 \implies$ capital requirements are never optimal.
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- Deadweight loss:
  - $\lambda > 0$ to capture negative effects of banks’ bad risk-taking
  - $\lambda = 0 \Rightarrow$ capital requirements are never optimal.
Equilibrium definition

- Firm managers maximize utility
- Banks maximize profits
- Households maximize utility
- Government budget constraint holds every period
- Labor, deposit, equity, and goods markets clear
Firms’ Choices

- Define

\[
\Delta_{t+1}^i \equiv \left( z_{t+1}^i - w_t \right) l_t + R_t^d d_t
\]

which is the marginal utility of wealth.
Firms’ Choices

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- Labor demand \( l_t \):

\[
0 = E_t \left\{ \frac{z_{t+1}^i - w_t}{\Delta_{t+1}^i} \right\}
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return hiring an extra worker
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  - If \( z_{t+1}^i = \bar{z} \) is not random, then \( w_t = \bar{z} \) and firms have no profits to return to households.
  - If \( z_{t+1}^i \) is random, then \( w_t < E_t \left\{ z_{t+1}^i \right\} \) and firms are profitable on average.
Irrelevance Result

- Suppose $z_{i,t+1}$ is not random (no good risk-taking).
- Suppose $\lambda = 0$ (no deadweight loss from default).
- Then: capital requirements have no real effects on the economy.
  - Reason:
    - Depositors at failed banks made whole through deposit insurance.
    - Taxes to pay for deposit insurance exactly offset losses from failed banks.
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Irrelevance Result

- Suppose $z^i_t + 1$ is not random (no good risk-taking).
- Suppose $\lambda = 0$ (no deadweight loss from default).
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- Reason:
  - Depositors at failed banks made whole through deposit insurance.
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- Reason:
  - Depositors at failed banks made whole through deposit insurance.
  - Taxes to pay for deposit insurance exactly offset losses from failed banks.
Now suppose $z_{t+1}$ is random (but $\lambda = 0$ still).

Taxes are still offsetting: no real effects of bank default.

As capital requirements rise, banks reduce deposits and $R_d^t$ falls.

Lower $R_d^t$ induces firms to reduce their labor demand.

Lower labor demand leads to reduced output, wealth, and welfare.

When $\lambda > 0$, increasing capital requirements also reduces the deadweight loss from bank default.
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Capital Requirements and Good Risk-Taking

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- Increasing capital requirements $\zeta$
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  - Volatility of firms’ wealth in $t+1 \uparrow$

$$x^i_{t+1} = \left(1 - \tau_{t+1}^{\text{tax}}\right) \left[ (Z_{t+1}^i - W_t) l_t + \underbrace{R^d_t d_t}_{\text{return deposits (safe)}} \right]$$

- Labor demand $l_t \downarrow \Rightarrow$ Wealth in $t+1$: $X_{t+1} \downarrow$
Capital requirements with stochastic $z_{t+1}^i$

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Numerical Example

Assume $\varepsilon_{t+1} \sim \log N(\sigma)$

$z' \sim \begin{cases} 0 \text{ probability } 1 - p \\ z_1 \text{ probability } p \end{cases}$

Set $A$, $\sigma$, and $\nu_1$ to match steady-state consumption = 1 bank default probability when $\zeta = 10\% = 10\%$

Deposit premium $\beta - R_d = 2\%$

Other parameters
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other parameters
Labor Demand

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![Graph showing the relationship between capital requirement and labor demand. The graph indicates that as capital requirements increase, labor demand decreases, with different curves for different deposit returns (1.4%, 2%, 2.5%, 3%).]
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Default Probability

![Graph showing the relationship between capital requirement and default probability](image-url)
Welfare

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- With $\lambda = 0$, there is no benefit to capital requirements, only a cost.
- With $\lambda > 0$, the cost is balanced against a reduced deadweight loss.
Good Risk-Taking vs. Utility from Deposits

Assume $\lambda = 0$ (no bad risk-taking).

Frisch elasticity $\nu^2$ is key for welfare costs of capital requirements.

$\nu^2 \to \infty$: labor fully flexible, wage fixed

Increasing capital requirements has large negative effects on welfare

$\nu^2 \to 0$: labor fixed, wage fully flexible

Increasing capital requirements has no negative effect on welfare

In either case, $R_d < 1$

Positive deposit premium $\neq \Rightarrow$ positive marginal social value of deposits

In contrast to theories with deposits in the utility function
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Increasing capital requirements has large negative effects on welfare when $\nu_2 \to \infty$: labor fully flexible, wage fixed.

Increasing capital requirements has no negative effect on welfare when $\nu_2 \to 0$: labor fixed, wage fully flexible.

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  - Increasing capital requirements has large negative effects on welfare
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- We propose a new channel:
  Financial regulation affect risk-taking capacity of non-financial firms
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- Only ~ 50% of deposits in the U.S. are insured.
  - Adds another channel: capital requirements *do* make agents’ portfolios safer, in addition to the deposit insurance subsidy.
Numerical example: parameter values

<table>
<thead>
<tr>
<th>Set Parameters</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>0.95</td>
</tr>
<tr>
<td>$\nu_2$</td>
<td>1</td>
</tr>
<tr>
<td>$p_z$</td>
<td>0.70</td>
</tr>
<tr>
<td>$\bar{k}$</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Calibrated Parameters</th>
<th>Value</th>
<th>Target</th>
<th>Target Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A$</td>
<td>0.135</td>
<td>Steady-State $c$</td>
<td>1</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>0.079</td>
<td>Banks Default Probability</td>
<td>10%</td>
</tr>
<tr>
<td>$\nu_1$</td>
<td>1.038</td>
<td>Deposit Premium $\frac{1}{\beta} - R^d$</td>
<td>2%</td>
</tr>
</tbody>
</table>
Government: tax rate

- Tax rate on wealth of entrepreneurs $\tau_{t+1}$:

\[
\tau_{t+1} = \frac{T_{t+1}}{\int \left[ (z_{t+1}^i - w_t) l_t^i + R_t^d d_t^i + R_t^E n_t^i \right] di}
\]
## Basel III Capital Requirements

The Basel III rules have imposed significant changes to the capital requirements of banks, affecting both the composition and the amounts of capital that banks must hold. 

### Aggregate capital ratios and (incremental) capital shortfalls

<table>
<thead>
<tr>
<th></th>
<th>Fully implemented requirement, in per cent</th>
<th>Basel III capital ratios, in per cent</th>
<th>Risk-based capital shortfalls, in billions of euros(^1)</th>
<th>Combined risk-based capital and leverage ratio shortfalls, in billions of euros(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Target(^2)</td>
<td>Transitional</td>
<td>Fully phased-in(^3)</td>
</tr>
<tr>
<td><strong>Group 1 banks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CET1 capital</td>
<td>4.5</td>
<td>7.0–9.5</td>
<td>12.2</td>
<td>11.9</td>
</tr>
<tr>
<td>Tier 1 capital(^4)</td>
<td>6.0</td>
<td>8.5–11.0</td>
<td>13.4</td>
<td>12.9</td>
</tr>
<tr>
<td>Total capital(^5)</td>
<td>8.0</td>
<td>10.5–13.0</td>
<td>15.8</td>
<td>14.6</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Group 2 banks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CET1 capital</td>
<td>4.5</td>
<td>7.0</td>
<td>13.8</td>
<td>13.4</td>
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<tr>
<td><strong>Sum</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) The shortfall is calculated as the sum across individual banks where a shortfall is observed. The calculation includes all changes to RWA (e.g., definition of capital, counterparty credit risk, trading book and securitisation in the banking book).

\(^2\) The target level includes the capital conservation buffer and the capital surcharges for 30 G-SIBs as applicable.

\(^3\) This is as agreed by the Basel Committee up to end-2015.

\(^4\) The shortfalls presented in the Tier 1 capital row are additional Tier 1 capital shortfalls.

\(^5\) The shortfalls presented in the total capital row are Tier 2 capital shortfalls.

Source: Basel Committee on Banking Supervision.
## Basel III Capital Ratios

### Fully phased-in Basel III CET1, Tier 1 and total capital ratios

<table>
<thead>
<tr>
<th>In per cent</th>
<th>Group 1 banks</th>
<th>Of which: G-SIBs</th>
<th>Group 2 banks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CET1</td>
<td>Tier 1</td>
<td>Total</td>
</tr>
<tr>
<td>Max</td>
<td>23.8</td>
<td>26.0</td>
<td>29.3</td>
</tr>
<tr>
<td>75th percentile</td>
<td>13.8</td>
<td>14.3</td>
<td>16.8</td>
</tr>
<tr>
<td>Median</td>
<td>12.1</td>
<td>13.0</td>
<td>14.5</td>
</tr>
<tr>
<td>25th percentile</td>
<td>10.9</td>
<td>11.6</td>
<td>13.1</td>
</tr>
<tr>
<td>Min</td>
<td>8.1</td>
<td>8.1</td>
<td>9.6</td>
</tr>
<tr>
<td>Weighted average</td>
<td>11.9</td>
<td>12.9</td>
<td>14.6</td>
</tr>
</tbody>
</table>

Source: Basel Committee on Banking Supervision.
Results (Increase DRS parameter $\alpha$)

- Increase $\alpha$ until unconstrained capital ratio $y = 2\%$.

- Match 1.7% crisis tax at $\gamma = 0.76$. 

![Graph showing the relationship between capital requirement and steady-state deviation from zeta=0]
Results (Increase wage intercept $\nu_1$)

- Increase $\nu_1$ until deposit premium $\frac{1}{\beta} - R^d = 50$ bps.

- Match 1.7% crisis tax at $\gamma = 0.7$. 

[Graph showing steady-state deviation from $\zeta=0$ vs. capital requirement (%)]
Results (Increase wage intercept $\nu_1$)

- Increase $\nu_1$ until deposit premium $\frac{1}{\beta} - R^d = 50$ bps.

- Match 1.7% crisis tax at $\gamma = 0.7$. 

![](image)
Numerical example (big shocks): parameter values

- $\nu_1 = 0.6612$
- $A = 1.032$
- $\nu_2 = 100$
- $\beta = 0.95$
- $p_c = 1%$
- $s = 8.9%$
- $\gamma = 0.66$
- $\alpha = 0.99989$
- $z_{t+1}^i \in \{0, A\}$, $Pr (z_{t+1}^i = A) = 0.7$
Welfare with $\nu_2 = 100$

- With $\lambda = 0$, there is no benefit to capital requirements, only a cost.
- With $\lambda > 0$, the cost is balanced against a reduced deadweight loss.