Capital Regulation, Liquidity Requirements and Taxation in a Dynamic Model of Banking

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The views expressed in this paper are those of the authors and do not necessarily represent those of the IMF

Motivation

- The 2007–2008 financial crisis showed Basel II capital accord inadequate to cope with large financial shocks.
- Proposed new Basel III regulations envision
  - raise in bank capital requirements;
  - liquidity requirements;
  - taxation of bank liabilities as a complementary regulatory tool (to discourage bank leverage and finance rescue funds).
- Yet, the literature offers no dynamic model of banking in which the impact of these policies on bank risk, efficiency and welfare can be assessed jointly.

Motivation (continued)

Research questions:

- Do capital requirements reduce or increase the risk of bank failure?
- How do capital requirements affect lending?
- What is the impact of liquidity requirements and taxation on bank risk and lending?
- What is the joint impact of bank regulations and taxation on welfare?

Our study provides an answer to all these questions.

Outline

A dynamic model of banking

- Banks
  - are exposed to both credit and liquidity risk
  - undertake maturity transformation (intermediation)
  - can resolve financial distress in three costly forms:
    - fire sales;
    - bond issuance;
    - equity issuance.
- Calibrate the model using U.S. yearly aggregate time series for the period 1983–2009 for the entire universe of banks included in the Federal Reserve Call Reports constructed by Corbae and D'Erasmo (2011).
- The impact of regulations and taxation is gauged comparing bank optimal policies and metrics of bank efficiency and welfare relative to an *unregulated* bank (the benchmark).

The Model

Time is discrete and the horizon is infinite.

The bank receives a random stream of short term deposits (D_t), can issue short term debt ($B_t < 0$), and invests in longer–term assets or loans (L_t) and short term bonds ($B_t > 0$).

Loans are risky and their return is subject to a credit shock (Z_t).

Maturity transformation: a constant proportion $\delta < 1/2$ of loans becomes due in one period (average loan maturity > 1).

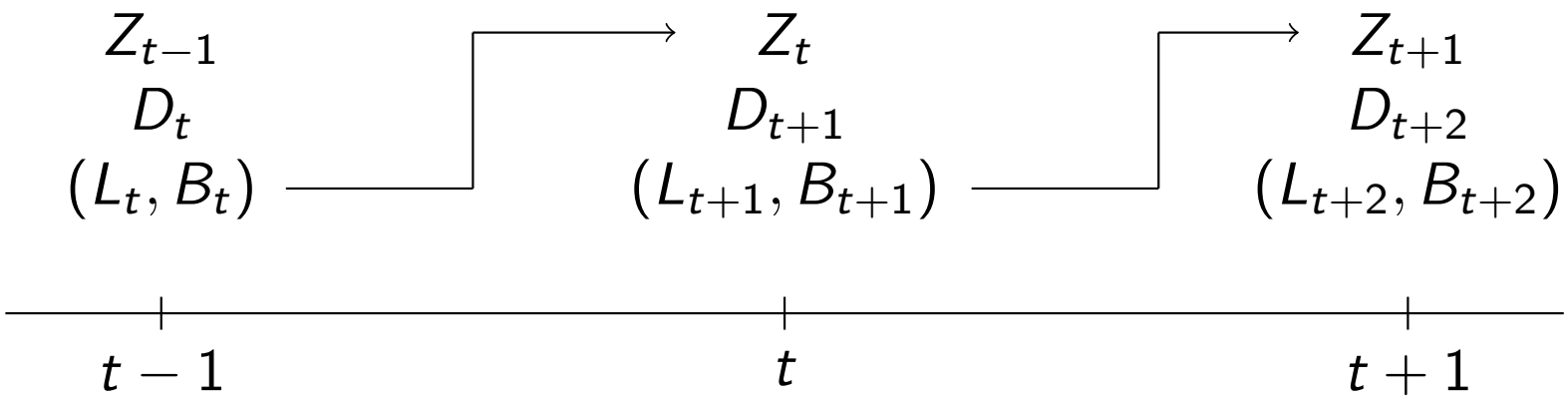
Costly reversibility: change in loans entails asymmetric convex monitoring/liquidation/securitization costs, $m^+ \leq m^-$ (fire sales).

Deposits are fully insured.

Short term debt ($B_t < 0$) is fully collateralized, therefore risk–free.

(Ex–ante) bank capital: $K_t = L_t + B_t - D_t$.

Dynamics



$$Z_t - Z_{t-1} = (1-\kappa_Z)\left(\overline{Z} - Z_{t-1}\right) + \sigma_Z \varepsilon_t^Z$$
$$\log D_t - \log D_{t-1} = (1-\kappa_D)\left(\log \overline{D} - \log D_{t-1}\right) + \sigma_D \varepsilon_t^D$$

with correlation ρ.

The state is $x_t = (L_t, B_t, D_t, Z_t, D_{t+1})$.

Given x_t, the manager decides (L_{t+1}, B_{t+1}) to maximize shareholders' value (no managerial agency conflicts).

The Model (continued)

Financial distress: when total after tax internal cash available to the bank is negative,

$$y_t - \mathcal{T}(y_t) + B_t + \delta L_t + (D_{t+1} - D_t) < 0,$$

which is resolved by

- selling loans at "fire sale" prices (m^-)
- by issuing collateralized bonds,
- by injecting equity capital (λ).

If the bank is insolvent, shareholders exercise the limited liability option, and the bank defaults.

Assets transferred to insurance agency, net of costs, γD_t.

After default, restructured bank has deposits D_{t+1}, capital $K_{t+1} = D_u - D_{t+1} > 0$, bond investment $B_{t+1} = D_u$, and no loans, $L_{t+1} = 0$.

Valuation of securities and the bank's program

Market value of equity

$$E(x) = \max\left\{0, \max_{(L',B')\in\Gamma(D')} \left\{e(x, L', B') + \beta\mathbb{E}\left[E(x')\right]\right\}\right\},$$

Market value of deposits

$$F(x) = \beta D'(1 + r_d)\left(1 - \gamma P(x)\right).$$

Net value to the government

$$G(x) = (1 - \Delta(x))\left(\mathcal{T}(y') + \beta\mathbb{E}[G(x')]\right) - \Delta(x)\left(\gamma D + K_{t+1}\right).$$

Enterprise value: $V(x) = E(x) + F(x) - B$

Social value: $SV(x) = E(x) + D - B + G(x) + FC(x)$,

with FC value of expected equity floatation costs.

Bank Regulation

- **Capital requirement**:

$$\frac{K}{L} \geq k.$$

- **Liquidity coverage ratio**:

$$\frac{\delta L + Z_d \pi(L) - \mathcal{T}(y^{\min}) + B(1+r)}{D(1+r) - D_d} \geq \ell.$$

Calibration

κ_Z	annual persistence of the credit shock	0.88
σ_Z	annual conditional std. dev. of the credit shock	0.0139
$\overline{Z}$	unconditional average of the credit shock	0.0717
κ_D	annual persistence of the log of deposits	0.95
σ_D	annual conditional std. dev. of the log of deposits	0.0209
ρ	correlation between log–deposit and credit shock	-0.85
β	annual discount factor	0.95
r_f	annual risk–free rate on bonds	2%
r_d	annual rate on deposits	0%
τ^+	corporate tax rate for positive earnings	15%
τ^-	corporate tax rate for negative earnings	5%
δ	annual percentage of reimbursed loan	20%
γ	bankruptcy costs	0.1
λ	flotation cost for equity	0.1
α	return to scale for loan investment	0.90
m^+	unit price for loan investment	0.03
m^-	unit price for loan fire sales	0.04
k	percentage of loans for capital regulation	4%
ℓ	liquidity coverage ratio	20%

The impact of capital requirements

	unreg	$k = 0$	4%	12%
Loan (book)	**4.78**	**6.14**	**6.37**	**5.90**
Net Bond Holdings (book)	-3.48	-3.82	-3.89	-3.05
Bank Capital (book)	-0.70	0.31	0.47	0.84
Equity (mkt)	4.49	4.82	4.87	4.90
Deposits (mkt)	1.89	1.91	1.91	1.91
Enterprise Value (mkt)	**9.88**	**10.58**	**10.71**	**9.90**
Government Value (mkt)	0.54	0.86	0.88	0.85
Social value (mkt)	**10.56**	**11.56**	**11.72**	**10.87**
Default/Closure Rate (pct)	**5.34**	**1.26**	**0.00**	**0.00**

The impact of capital requirements (continued)

- Capital regulation reduces bank default risk and increases intermediation
- There is an inverted U-shape relationship between tightness of capital requirements, efficiency, and welfare
- Intuition: mild capital requirements prompt banks to retain more earnings and invest them in productive lending relative to the unregulated bank
- The unregulated bank pays out more dividends
- When requirements are too tight, however, doing this becomes (ex-ante) too costly to shareholders, because the bank incurs equity floatation costs. Bank efficiency and welfare decline.

The impact of capital and liquidity requirements

	unreg	$\ell = 0.2$	0.5	$k = 0.12$
Loan (book)	**4.78**	**2.68**	**2.65**	**2.67**
Net Bond Holdings (book)	**-3.48**	**0.16**	0.26	0.22
Bank Capital (book)	-0.70	0.82	0.90	0.87
Equity (mkt)	4.49	3.69	3.74	3.72
Deposits (mkt)	1.89	1.91	1.91	1.91
Enterprise Value (mkt)	**9.88**	**5.43**	**5.38**	**5.40**
Government Value (mkt)	0.54	0.37	0.37	0.37
Social value (mkt)	**10.56**	**5.91**	**5.86**	**5.89**

The impact of capital and liquidity requirements (continued)

- Liquidity requirements reduce efficiency and social value and nullify the benefits of mild capital requirements
- Efficiency and social losses increase with their stringency
- Intuition: liquidity requirements severely hamper banks' maturity transformation, forcing banks to reduce lending by investing in risk–free securities.

The impact of taxation

Two ways:

- Increase in corporate income taxes
- Introduce Pigouvian taxation on non–deposits liabilities to:
  - address the budgetary costs of the crisis (ex-post),
  - create resolution funds to address future distress (ex-ante),
  - align managers' incentives to target levels of bank risks, and
  - control systemic risk in the banking system.

The impact of taxation (continued)

	Capital			*Capital & liquidity*		
	base	τ	τ_B	base	τ	τ_B
Loan (book)	**6.37**	**6.09**	**5.89**	2.68	2.48	2.63
Net Bond Holdings (book)	-3.89	-3.62	-3.44	0.16	0.24	0.21
Bank Capital (book)	0.47	0.45	0.45	0.82	0.70	0.81
Equity (mkt)	4.87	4.49	4.46	3.69	3.38	3.65
Deposits (mkt)	1.91	1.91	1.91	1.91	1.91	1.91
Enterprise Value (mkt)	**10.71**	**10.06**	**9.84**	5.43	5.05	5.34
Government Value (mkt)	**0.88**	**1.14**	**1.10**	0.37	0.48	0.38
Social value (mkt)	11.72	**11.31**	**11.05**	5.91	5.64	5.83

The impact of taxation (continued)

- An increase in both corporate income taxes and non–deposit liabilities taxes reduce lending, and therefore efficiency.
- The value of tax receipts increases more with corporate income taxes than with the introduction of liability taxes.
- The negative impact on lending and efficiency is lower with income taxes than with non–deposit liabilities taxes.
- Overall, the negative impact on social value is lower with income taxes.

Conclusions

- The relationship between the tightness of capital requirements and efficiency and social value is an inverted U-shaped
- Liquidity requirements severely hamper banks' maturity transformation
- To raise tax revenues, corporate income taxes seems preferable to taxes on liabilities
- Taxes reduce bank efficiency, without increasing social value. However, this is still an under–researched area.

Thank you!