Systematic Bankruptcy and Financial Policy Relevance

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Contribution

What gaps remain in policy modelling aimed at determining banks' optimal financial policy?

Despite extensive post-crisis research, the literature focused on the Cost-Benefit Analysis (CBA) of capital regulation still lacks a general equilibrium model capable of consistently capturing the trade-offs of deleveraging in terms of *crisis costs and likelihood*, while enabling a *welfare analysis* of capital regulation.

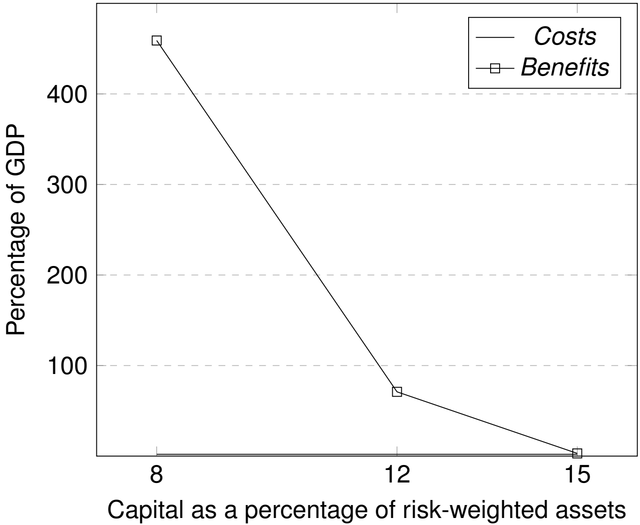
State of the art

The 2008 crisis triggered various CBA of capital regulation:

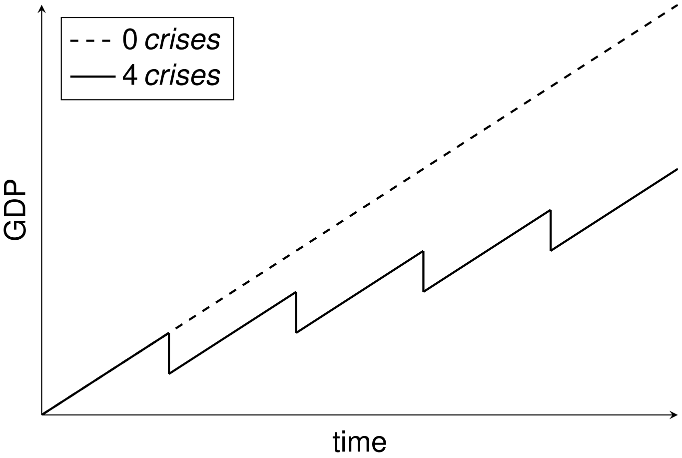
- Barrell et al. (2009)
- Bank of England (2010)
- Basel Committee on Banking Supervision (2010) *BIS*
- Schanz et al (2011) *BIS*
- Miles et al (2013) *Economic Journal*
- Brooke et al (2015) *BoE*
- Fender and Lewrick (2016) *BIS*
- Firestone et al (2017) *FRB*
- Cline (2017) *Peterson Institute*
- FRB Minneapolis (2017)
- Almenberg et al (2017) *Sveriges Riksbank*
- Barth and Miller (2018) *Journal of Financial Stability*
- Birn et al. (2020) *Journal of Risk and Financial Management*
- Gao and Ghosh (2024) *Quarterly Review of Economics and Finance*

Result: Deleveraging yields net benefits $\Rightarrow$ Basel 3 was right.

The Schanz et al (2011) calibration



Cost of crises



Open questions

There are theoretical concerns regarding the models underpinning these CBAs.

- Costts' model:
  Leverage $\downarrow \Rightarrow$ *funding costs* $\uparrow \Rightarrow$ *MPK* $\uparrow \Rightarrow$ *output losses*.
- Benefits' model:
  Leverage $\downarrow \Rightarrow$ *bankruptcy probability* $\downarrow + \overline{\textit{crisis costs}} \Rightarrow$ *output gains*.

Admati et al. (2013): Deleveraging does not alter funding costs.

Cochrane (2017): Lower bankruptcy risk reduces crisis costs.

Research objective

To develop a general equilibrium model where *the costs and benefits of deleveraging* are formulated as two expressions of the same phenomenon: *the relevance of financial policies* in scenarios of multiple bankruptcies and missing markets.

Detemple et al (1995) define *the relevance of financial policy* as the possibility of modifying equilibrium allocations through changes in firms' financial policies.

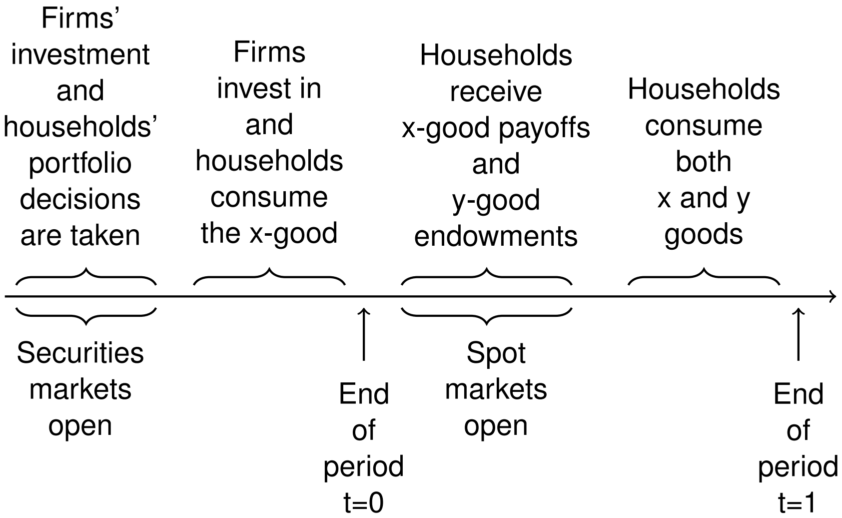
Literature on Financial Policy Relevance

- Partial equilibrium: Modigliani-Miller (1958).
- General equilibrium with complete markets: Stiglitz(1969, 1974).
- General equilibrium with incomplete markets: DeMarzo (1988).
- General equilibrium with incomplete markets and nonlinearities:
  - derivatives: Gottardi (1995).
  - trading constraints: Atesagaoglu and Carceles-Poveda (2015).
  - limited liability (default): Dubey et al. (2005), Zame (1993).
  - limited liability (bankruptcy): Geanakoplos (1990), Magill and Quinzii (1996).

The model

- Two periods.
- S states of nature at t=1.
- Two goods: a consumption-capital-numeraire good (x) and a pure-consumption good (y).
- F firms use a random CRS technology that requires k_0^f to produce $a_s^f k_0^f$.
- Limited liability and liquidation technology for all.
- F debt and F equity markets open at t=0 (price vector q).
- Nature provides households with X_0^h and Y_s^h.
- S spot markets open at t=1 (price vector p).
- H households chose ζ_f^h and δ_f^h and consume x_0^h, x_s^h and y_s^h.

Timeline


Firms' investment and households' portfolio decisions are taken
Firms invest in and households consume the x-good
Households receive x-good payoffs and y-good endowments
Households consume both x and y goods
Securities markets open
End of period t=0
Spot markets open
End of period t=1

Securities' markets

- Debt is a zero net supply security: $\sum_{h=1}^{H} \delta_f^h - \delta_f^f = 0$.
- Equity is a positive net supply security: $\sum_{h=1}^{H} \zeta_f^h = 1$.
- The security price vector is:

$$q = \begin{bmatrix} q_d \\ q_e \end{bmatrix} = \begin{bmatrix} q_d^1 \\ q_d^2 \\ \dots \\ q_d^F \\ q_e^1 \\ \dots \\ q_e^F \end{bmatrix},$$

Securities' payoffs

- Debt pays:

  $min(-\frac{a_s^f k_0^f}{\delta_f^f}, 1)$ at $t = 1$.

- Equity pays:

  $-k_0^f - q_f^d \delta_f^f$ at $t = 0$

  $max\left(a_s^f k_0^f + \delta_f^f, 0\right)$ at $t = 1$.

Payoffs' structure

$$R(k_0, \delta) =$$

$$\begin{bmatrix} 1 & min\left(-\frac{a_1^2 k_0^2}{\delta_2^2}, 1\right) & ... & min\left(-\frac{a_1^F k_0^F}{\delta_F^F}, 1\right) & a_1^1 k_0^1 + \delta_1^1 & ... & max\left(a_1^F k_0^f + \delta_F^F, 0\right) \\ ... & ... & ... & ... & ... & ... & ... \\ 1 & min\left(-\frac{a_s^2 k_0^2}{\delta_2^2}, 1\right) & ... & min\left(-\frac{a_s^F k_0^F}{\delta_F^F}, 1\right) & a_s^1 k_0^1 + \delta_1^1 & ... & max\left(a_s^F k_0^F + \delta_F^F, 0\right) \end{bmatrix} =$$

$$\begin{bmatrix} 1 & min\left(-\frac{a_1^2 k_0^2}{\delta_2^2}, 1\right) & ... & min\left(-\frac{a_1^F k_0^F}{\delta_F^F}, 1\right) & a_1^1 k_0^1 + \delta_1^1 & ... & a_1^F k_0^F + \delta_F^F min\left(-\frac{a_1^F k_0^F}{\delta_F^F}, 1\right) \\ ... & ... & ... & ... & ... & ... & ... \\ 1 & min\left(-\frac{a_s^2 k_0^2}{\delta_2^2}, 1\right) & ... & min\left(-\frac{a_s^F k_0^F}{\delta_F^F}, 1\right) & a_s^1 k_0^1 + \delta_1^1 & ... & a_s^F k_0^F + \delta_F^F min\left(-\frac{a_s^F k_0^F}{\delta_F^F}, 1\right) \end{bmatrix}$$

The h^{th} household's problem

Two versions:

$$\max_{x^h, y^h, \zeta^h, \delta^h} u^h(x_0^h) + \sum_{s=1}^{S} \pi_s v^h(x_s^h, y_s^h)$$

$$+\mu^h \left(\begin{bmatrix} X_0^h - x_0^h \\ x^h + diag(p)(y^h - Y^h) \end{bmatrix} - \begin{bmatrix} \begin{bmatrix} q_d \\ q_e + k_0 - diag(\delta) q_d \end{bmatrix}^\top \\ R(k_0, \delta) \end{bmatrix} \begin{bmatrix} \delta^h \\ \zeta^h \end{bmatrix} \right)$$

$$\max_{x^h, y^h} \quad u^h(x_0^h) + \sum_{s=1}^{S} \pi_s v^h(x_s^h, y_s^h)$$

$$\text{s.t.} \quad \begin{bmatrix} X_0^h - x_0^h \\ x^h + diag(p)(y^h - Y^h) \end{bmatrix} \in C \begin{bmatrix} \begin{bmatrix} q_d \\ q_e + k_0 - diag(\delta) q_d \end{bmatrix}^\top \\ R(k_0, \delta) \end{bmatrix}$$

The f^{th} firm's problem

Two versions:

$$\max_{k_0^f} \quad q_f^e$$

$$\max_{k_0^f} \quad -k_0^f - \delta_f^f q_d^f + \sum_{h=1}^{H} \sum_{s=1}^{S} \left(\zeta_f^h \left(\frac{\pi_s v_h'(x_s^h, y_s^h)}{u_h'(x_0^h)} \right) \left(a_s^f k_0^f + \delta_f^f min \left(-\frac{a_s^f k_0^f}{\delta_f^f}, 1 \right) \right) \right)$$

Equilibrium

Given beliefs, preferences, technology, endowments, and financial policies a *General Equilibrium with Multiple Bankruptcies* can be defined as the septet $(\bar{x}^h)_{h=1}^H, (\bar{y}^h)_{h=1}^H, (\bar{\delta}^h)_{h=1}^H, (\bar{\zeta}^h)_{h=1}^H, (\bar{k}_0^f)_{f=1}^F, \bar{q},$ *and* $\bar{p}$ such as:

- H households solve their problems.
- F firms solve their problems.
- F + F + S markets clear.

Intuition

- Key feature:

  Δ *firms financial policies* $\Rightarrow$ Δ*payoff structure* $\Rightarrow$ Δ*households' consumption allocations* $\Rightarrow$ Δ*SDF* $\Rightarrow$ Δ*firms' investment plans* $\Rightarrow$ Δ*output*.

- Central trade-off:

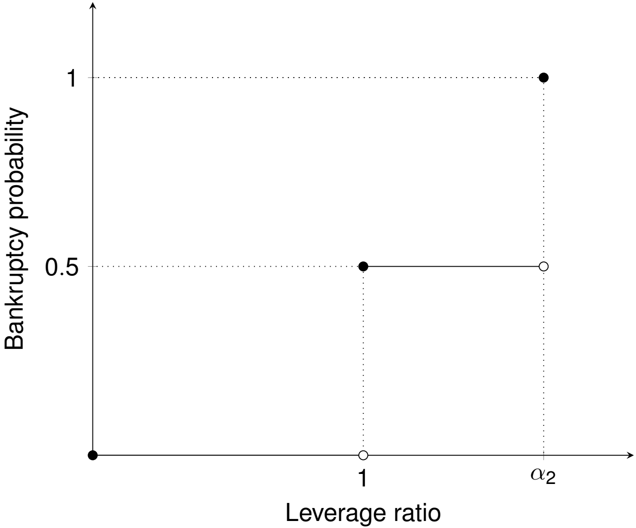
  In the absence of bankruptcy, investment is suboptimal; yet systematic bankruptcy also results in underinvestment.

  Therefore, the optimal financial policy is one that expands the payoff structure while avoiding excessive bankruptcy risk.

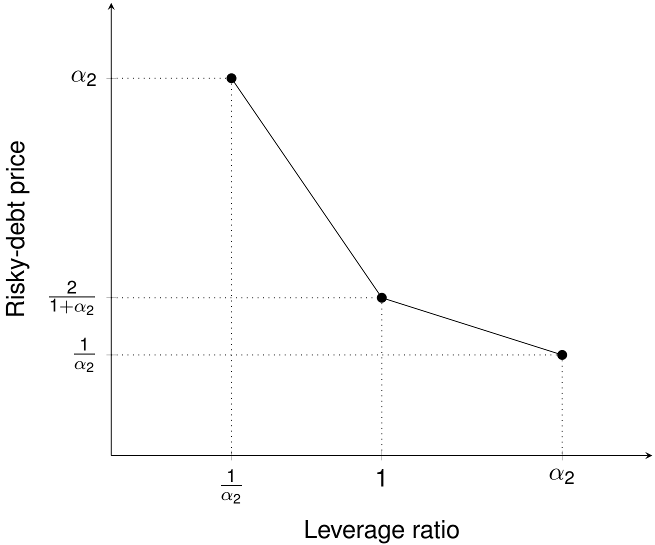
An example

- Two periods, two goods, two states of nature, two households, one firm.
- States of nature are equiprobable: $\pi_1 = \pi_2 = 0.5$.
- The single firm produces the x-good with a random CRS technology whose productivity factor can be either $\alpha_1 = 1$ or $\alpha_2 > 1$.
- One household's utility function is a logarithmic transformation of the other.
- Equilibrium:
    - 1 investment plan,
    - 4 prices (equity, debt and 2 spot markets), and
    - 10 consumption levels ($x_{s=0,1,2}^{h=A,B}$ and $y_{s=1,2}^{h=A,B}$)

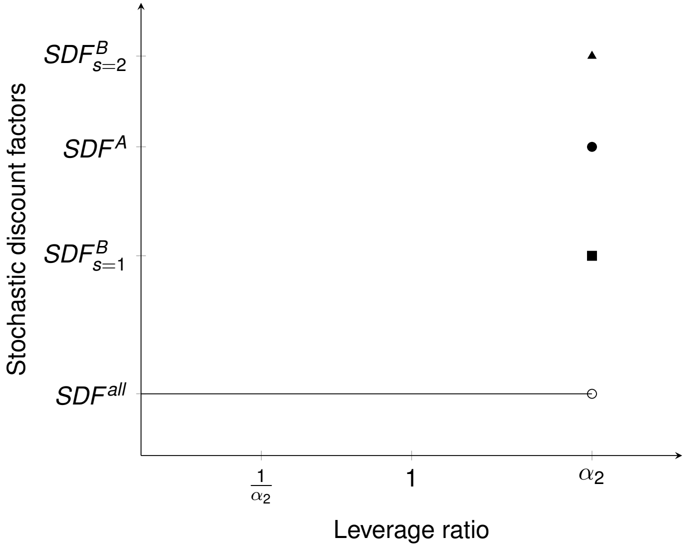
Bankruptcy probability



Risky-debt pricing function



Stochastic discount factors (SDF)



Conclusion

The model provides a consistent CBA story:

Leverage $\downarrow\Rightarrow$ *bankruptcy probability* $\downarrow\Rightarrow$ $\overline{\textit{funding costs}}$ $\Rightarrow$ *SDF* $\downarrow\Rightarrow$ *output* $\uparrow\Rightarrow$ *crisis costs* $\downarrow$.

Outstanding issues/Future research

- Welfare analysis.
- Optimal (bank) capital ratios calibration.

- Consumption and stock prices modelling.
- Higher betas estimation.
- Risk-off explanation.

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