Macroprudential Policy and Financial Turmoil

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Research question

- How should macroprudential policy be designed to mitigate the frequency and magnitude of financial turmoil and contain its consequences for the real economy?
  - What is the role of monetary policy in this context?

Motivation

- European Systemic Risk Board specifies objective of macroprudential policy as "**preventing and mitigating [...] risks of disruption to the financial system with the potential to have serious consequences for the real economy**".
- Growing evidence for manifold interactions between macroprudential and monetary polices and financial stability implications of monetary policy.

→ Need for a framework which allows to address the effectiveness of (regime-dependent) macroprudential and monetary policies with respect to reducing the frequency of financial turmoil and its consequences for the real economy.

Our contribution

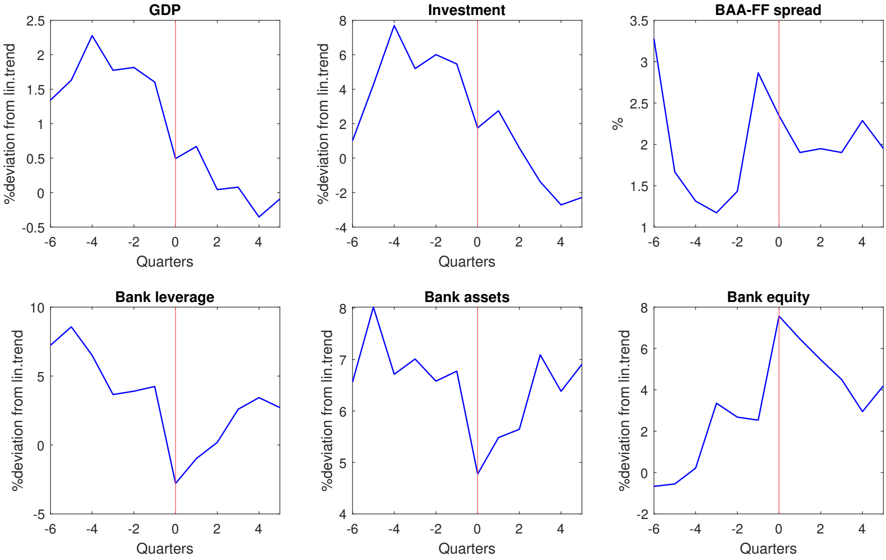
- We build a New Keynesian DSGE model with endogenous regime-switches between normal times (smaller financial frictions) and financially turbulent times (larger financial frictions).
- We calibrate the model in order to reproduce important dynamics of episodes of financial turmoil in the US.
- We use the model as a laboratory for macroprudential and monetary policy.
- We model macroprudential policy as a constant and a regime-dependent regulatory capital buffer.

literature

Main results

- Regime-specific capital buffers are more effective in reducing the frequency of financial turmoil than constant buffers.
- Both types of capital buffers lead to a reduction in volatility but also in real economic activity.
- If monetary policy is more accommodative during times of financial turmoil, episodes of financial turmoil are significantly shortened and welfare is increased.

Average dynamics around financial turmoil



US data, 1971Q1-2019Q4; Lopez-Salido/Nelson (2010) dates chronology

Model overview

- Agents:
  - Households
  - Intermediate goods producers
  - Final goods producers
  - Capital goods producers
  - Banks (as in Akinci/Queralto, 2022)
  - Monetary authority
  - Macroprudential authority
- Real rigidity: investment adjustment costs
- Nominal rigidity: sticky prices
- Shocks: technology shocks, monetary policy shocks, shocks to the net wealth of bankers

Banks

- Each bank channels deposits from households (d_t), net worth (n_t) and net proceeds from intra-period working capital loans ($(R_{L,t} - R_{t-1})s_{W,t}$) to intermediate goods producing firms ($Q_t s_t$),

$$Q_t s_t = d_t + n_t + (R_{L,t} - R_{t-1})s_{W,t}.$$

- Net worth evolves according to

$$n_t = R_{k,t} Q_t s_t + e_{t-1} - R_{t-1} d_{t-1},$$

where $R_{k,t}$ is the state-contingent gross real rate of return of capital assets and e_t is new equity provided to the bank by its respective household.

Financial friction

- Each period, fraction $1 - \theta(r_t)$ of bankers exits and pays out terminal net wealth to respective household. Hence, the bank maximizes the terminal value of its net wealth

$$V_t = \max \quad E_t \Lambda_{t,t+1} \big[(1 - \theta(r_t))(R_{k,t+1} Q_t s_t - R_t d_t) + \theta(r_t) \big[(V_{t+1}(n_{t+1}) - e_t) - C(e_t, n_t) \big] \big].$$

- Banker can choose to divert a fraction $0 < \lambda < 1$ of total assets and working capital loans ($\rightarrow$ bankruptcy). Hence, depositors only provide funds as long the following incentive constraint holds

$$V_t \geq \lambda (Q_t s_t + (1 - (R_{L,t} - R_{t-1})) s_{W,t}).$$

- $r_t \in (h, l)$ denotes the state of the economy at time t.

more

Banks aggregated

Net worth of existing and new bankers is given by

$$
\begin{aligned}
N_t &= N_{n,t} + N_{e,t}, \text{ with} \\
N_{e,t} &= \theta(r_t)\big[(R_{k,t} - R_{t-1})Q_{t-1}K_{t-1} + R_{t-1}N_{t-1} \\
&\quad + R_{t-1}(R_{L,t-1} - R_{t-2})s_{W,t-1} + e_t\big], \\
N_{n,t} &= \omega(r_t)Q_t S_{t-1},
\end{aligned}
$$

where $\omega(r_t)$ is the fraction of assets given to new bankers.

Equity issuance

- Banks can strengthen their balance sheet (i.e., increase net worth) by issuing equity.
- Equity issuance is costly,

$$C(e_t, n_t) = \left(\frac{\kappa(r_t)}{2}\right) x_t^2 n_t,$$

  where $x_t = \frac{e_t}{n_t}$.
- Optimally,

$$\nu_{e,t} = c'(x_t),$$

  where $\nu_{e,t}$ denotes the present net value of a transfer by the household to the bank, which increases tomorrow's net wealth, n_{t+1}, by one unit. $c'(x_t)$ is the marginal cost of an additional unit of net worth.

details

Calibration of regime-specific parameters

- Calibration affects deterministic steady state values, mean values, size and probability of regime-switches

→ Targets: ratio of the BAA-AAA spread of tranquil times to turbulent times of 60%; proportion of time in financial turmoil of 25%, mean duration of financial turmoil of 5 years

	"normal times" (**l**ow-FF)	"financially turbulent times" (**h**igh-FF)
quart. survival prob. of banker, $\theta(r_t)$	0.97	0.955
start-up funds for new bankers, $\omega(r_t)$	0.001	0.005
equity issuance cost parameter, $\kappa(r_t)$	28	30
det. st. st. spread	63bps	100bps
det. st. st. leverage	3.8	3.7

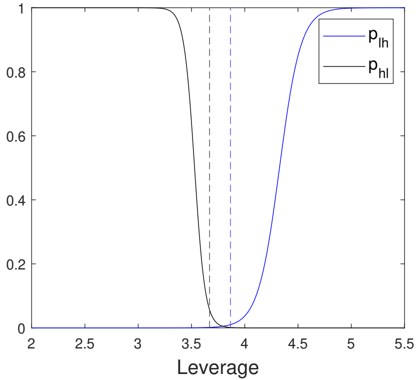
Endogenous regime switching

Transition probabilities between regimes are endogenously determined by leverage (ϕ_t),

$$p_{lh,t} = \frac{\alpha_{lh}}{\alpha_{lh}+exp(-\psi_{lh}(\phi_t-\bar{\phi}_l))}$$

$$p_{hl,t} = \frac{\alpha_{hl}}{\alpha_{hl}+exp(\psi_{hl}(\phi_t-\bar{\phi}_h))}$$

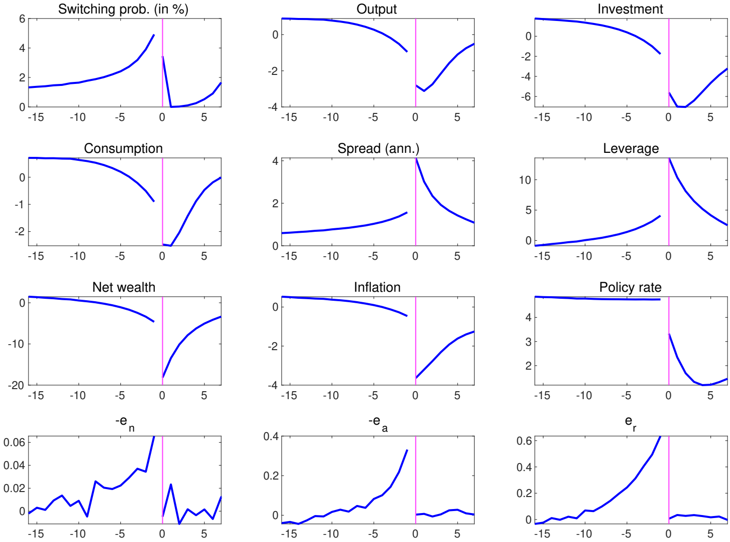
with $\psi_{lh} = 10$, $\psi_{hl} = 20$, $\alpha_{lh} = 0.01$, $\alpha_{hl} = 0.06$.



Banks' leverage is given by $\phi_t \equiv \frac{Q_t S_t + (1-(R_{L,t}-R_{t-1}))s_{W,t})}{N_t}$.

more | solution technique | IR to tech. shock | IR to net wealth shock | IR to monetary policy shock

Dynamics around financial turmoil



Model economy was simulated for 1,000,000 quarters with a burn-in period of 100,000 quarters. Only episodes were considered where the normal regime had lasted at least 20 quarters before the economy switched to the turbulent regime and where the subsequent turbulent regime lasted for at least 8 periods.

Model versus data

	Model	Data (LSN, 2010)
Dynamics around financially turbulent times:		
GDP	-3pp	-3pp
Investment	-6pp	-10pp
Leverage	6pp	4pp
Net worth	-14pp	-4pp
Spread	270bps	200bps
Crises times:		
Time in crisis (in %)	25.47	25.60
Mean length in quart. (l)	68.63	33.75
Mean length in quart. (h)	23.45	13.25

moments

Macroprudential policy

Purpose: Incentivize equity issuance to strengthen banks' balance sheets preemptively.

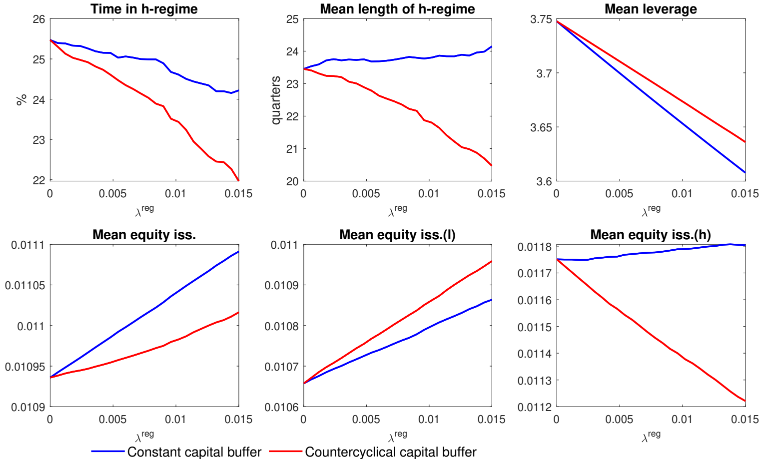
Implementation: Imposition of regulatory capital buffer λ^{reg},

$$\frac{V_t}{Q_t s_t + (1 - (R_{L,t} - R_{t-1}))s_{W,t}} \geq \lambda + \lambda^{\text{reg}}$$

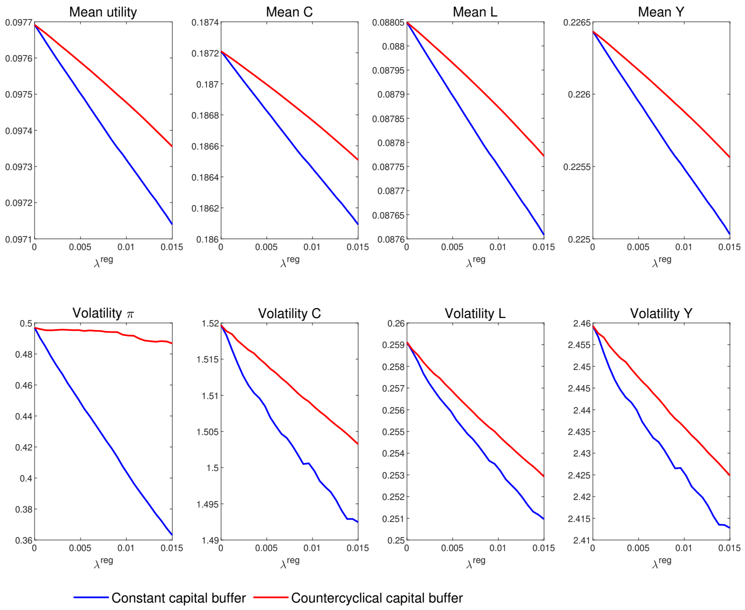
We are going to consider different policies:

1. constant capital buffer: $\lambda^{\text{reg}}(l) = \lambda^{\text{reg}}(h) > 0$
2. counter-cyclical (regime-dependent) capital buffer: $\lambda^{\text{reg}}(l) > 0$, $\lambda^{\text{reg}}(h) = 0$
3. *counter-cyclical (state-dependent and potentially regime-dependent) capital buffer:* $\lambda^{\text{reg}} = \tau + \tau_0(\Delta \frac{\text{credit}_t}{\text{GDP}_t})$

Effects of capital buffers (1)



Effects of capital buffers (2)



Regime-specific monetary policy

- Maih et al. (2021) find that, during the last two decades, Fed reacted more strongly to deteriorating macroeconomic conditions during times of financial distress.

	$\kappa_y = 0.125$ $\kappa_\pi = 1.50$	$\kappa_y(h) = 0.250$, $\kappa_\pi(h) = 1.60$	$\kappa_y = 0.250$ $\kappa_\pi = 1.60$
Cond. welfare	-152.865	-152.837	-153.033
Time in h-reg.	25.471	19.963	26.300
Length h-reg.	23.454	17.033	17.383
Length l-reg.	68.627	68.291	48.743
Spread (mean)	0.718	0.543	1.042
Leverage (mean)	3.748	3.728	3.773
Y (mean)	0.226	0.229	0.223
Y (var)	2.459	2.495	2.431
C (mean)	0.187	0.189	0.185
C (var)	1.520	1.540	1.505
L (mean)	0.088	0.089	0.087
L (var)	0.259	0.266	0.262

Conclusion

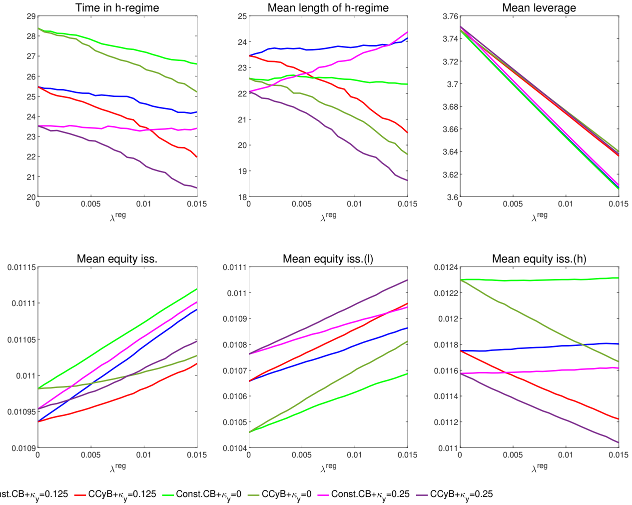
- Model reproduces dynamics of real and financial variables with respect to periods of financial turmoil.
- Capital buffers have preemptive effects: incentivize equity issuance during good times $\rightarrow$ financial crises become less likely to occur and less strong.
- Regime-dependent capital buffers more effective in reducing occurrences of financial crises than constant ones.
- All capital buffers reduce volatility but constrain macroeconomic activity.
- Monetary policy, which is more accommodative during times of financial distress, makes crises episodes less frequent and shorter.
- With stronger output stabilization through central bank, capital buffers are less effective in reducing episodes of financial turmoil, especially constant buffers. plots

Thank you for your attention!

Consideration of output stabilization (1)

$$\frac{R_t^n}{R^n} = \left(\frac{R_{t-1}^n}{R^n}\right)^{\rho_r} \left(\frac{\pi_t}{\pi}\right)^{\kappa_\pi(1-\rho_r)} (\hat{y}_t)^{\kappa_y(1-\rho_r)} e_{t,R},$$

with $\kappa_\pi = 1.5$ and $\kappa_y = 0.125$ in the benchmark case. Alternatives assume $\kappa_\pi = 1.5$ and $\kappa_y = (0, 0.250)$.



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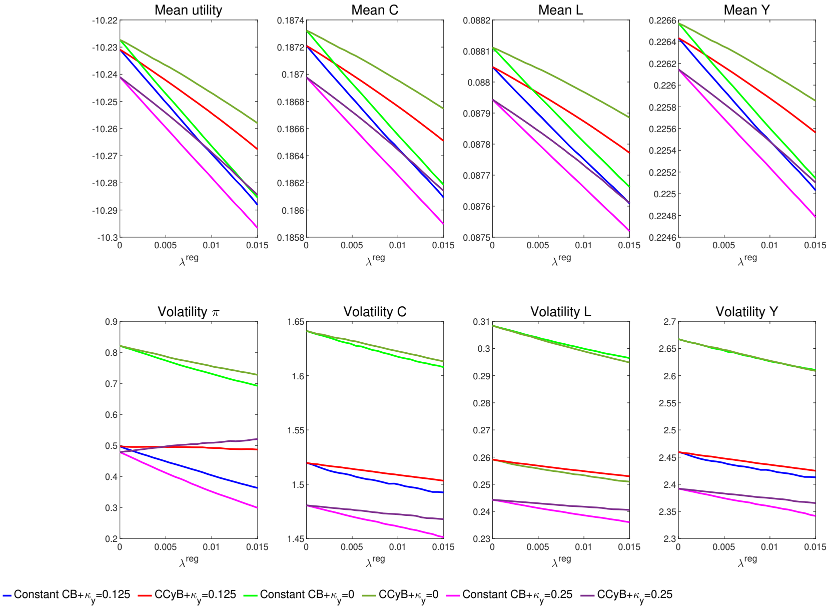
Consideration of output stabilization(2)



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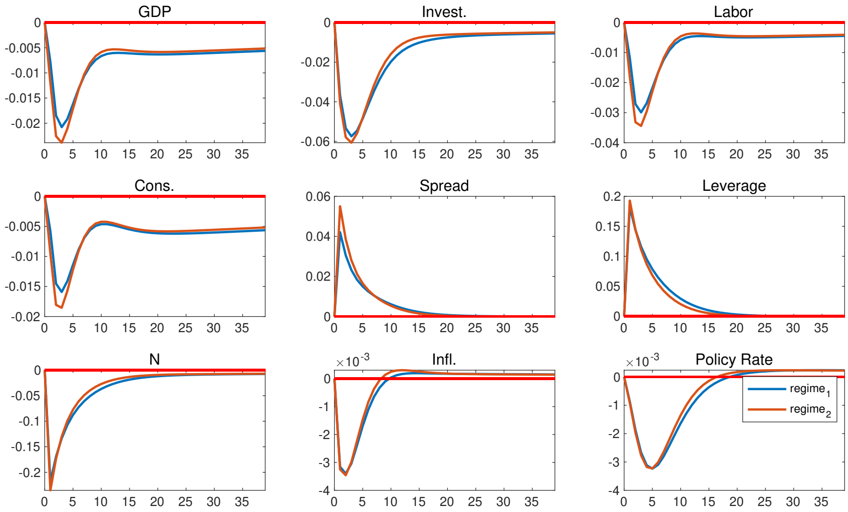
Impulse responses to a negative net wealth shock



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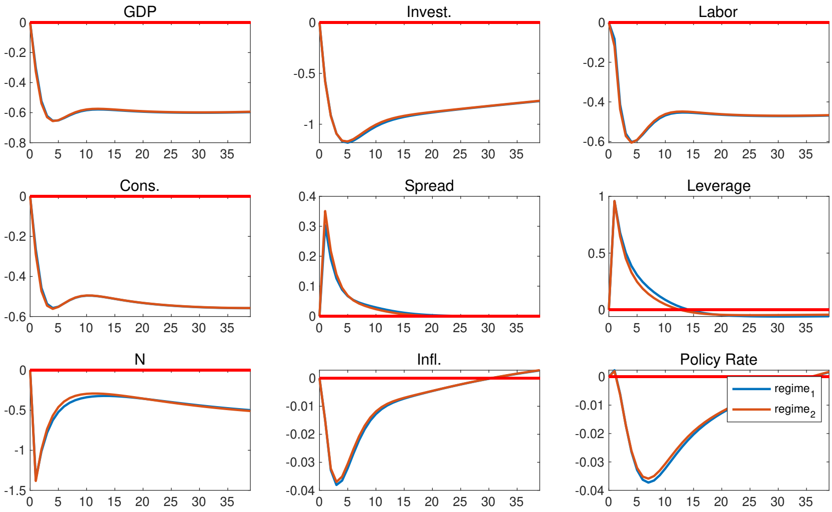
Impulse responses to a negative technology shock



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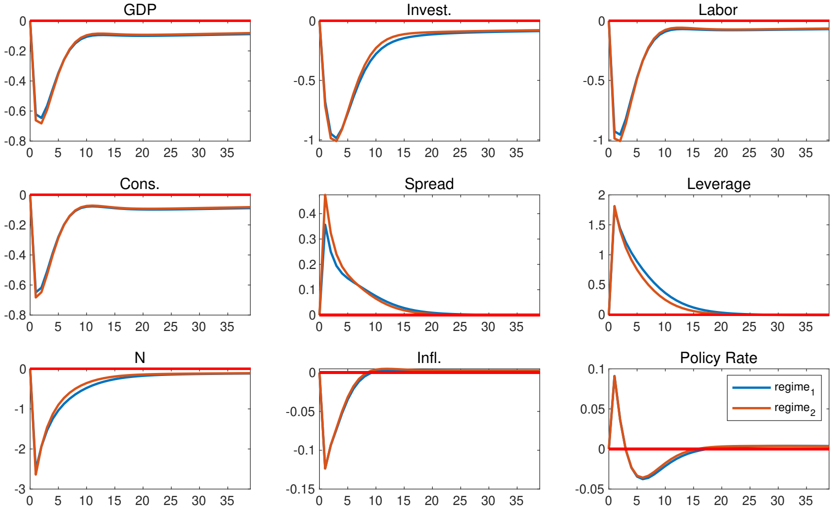
Impulse responses to a contractionary monetary policy shock



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Related literature

- Macroprudential policies in constant-parameter DSGE models: Gelain and Ilbas (2017), Leduc and Natal (2017), De Paoli and Paustian (2017), Tayler and Zilberman (2016), Bailliu et al. (2015), Angelini et al. (2014) etc.
- Macroprudential policy in DSGE models with financial regime switches (FRS) or occasionally binding financial constraints (OBFC): Akinci and Queralto (2022), Karmakar (2016), Mendoza (2010), Bianchi and Mendoza (2018) etc.
- Monetary policy and FRS/OBFC: Boissay et al. (2021)

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Chronology of US financial crises

Crises	Period	LSN	RR	LV	BB
Commercial bank capital squeeze	1973-1975	✓	-	-	✓
Less developed countries debt threat	1982-1984	✓	-	-	✓(*)
Savings and loan crisis	1988-1991	✓	✓(*)	✓(*)	✓
Asian crisis and NASDAQ bubble	1997-2002	-	-	-	✓
Great Recession	2007-2009	✓	✓	✓(*)	✓(*)

SN: Lopez-Salido/Nelson (2010); RR: Reinhard/Rogoff (2009); LV: Laeven/Valencia (2012, 2018); Brave/Butters (2012). Time frame: 1971Q1-2019Q4. (*)Different timing

Time in a crisis: 8% – 45%

Duration: 1year - 7years

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Banks' problem – Sketch of solution

Guess that the value function is linear in net worth, $V_t(n_t) = \gamma_t n_t$.

$$\begin{aligned} \text{Let } \mu_t &\equiv E_t \Lambda_{t,t+1}(1-\theta(r_t)+\theta(r_t)\gamma_{t+1})(R_{k,t+1}-R_t), \\ \upsilon_t &\equiv E_t \Lambda_{t,t+1}(1-\theta(r_t)+\theta(r_t)\gamma_{t+1})R_t, \\ \nu_{e,t} &\equiv E_t \Lambda_{t,t+1}(\gamma_{t+1}-1). \end{aligned}$$

Now, the problem of the bank simplifies to

$$\gamma_t n_t = \max_{s_t, s_{W,t}, e_t} \mu_t Q_t s_t + \upsilon_t \Delta_{L,t} s_{W,t} + \theta(r_t)(\nu_{e,t} e_t - C(e_t, n_t))$$

subject to the incentive constraint

$$\begin{aligned} \mu_t Q_t s_t + \upsilon_t \Delta_{L,t} s_{W,t} + \upsilon_t n_t + \theta(r_t)(\upsilon_t e_t - C(e_t, n_t)) \\ \leq \lambda(Q_t s_t - (1-\Delta_{L,t}) s_{W,t}). \end{aligned}$$

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First-order conditions

$$
\begin{aligned}
(1+\xi_t)\mu_t &= \xi_t \lambda \\
(1+\xi_t)\upsilon_t \Delta_{L,t} &= \xi_t \lambda (1-\Delta_{L,t}) \\
\nu_{e,t} &= C'(e_t, n_t),
\end{aligned}
$$

where ξ_t is the Lagrange multiplier on the incentive constraint and $x_t \equiv \frac{e_t}{n_t}$.

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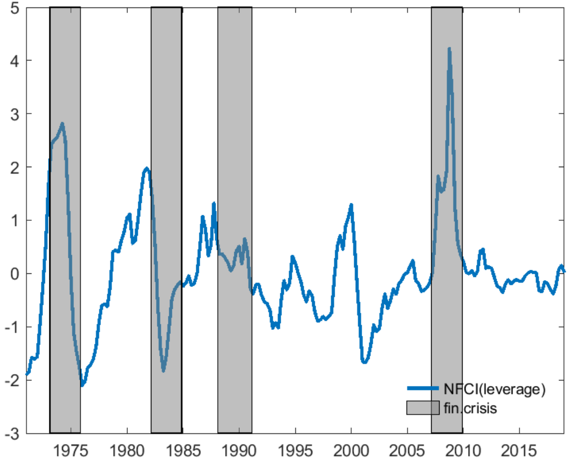
Episodes of financial crises using LSN methodology



Brave/Butters (2012): Leverage signals the development of financial imbalances. back to main

Solution technique (Maih/Waggoner, 2018)

- The problem to solve

$$\mathbb{E}_t \left[\sum_{r_{t+1}=1}^{h} p_{r_t r_{t+1}}(\mathcal{I}_t) f_{r_t}(x_{t+1}(r_{t+1}), x_t(r_t), x_{t-1}, \theta_{r_t}, \theta_{r_{t+1}}, \epsilon_t) \right] = 0,$$

  where x_t - vector of model variables, r_t - switching process with h different states, θ_{r_t} - vector of parameters in state r_t, $p_{r_t r_{t+1}}(\mathcal{I}_t)$ - transition probability, $\mathcal{I}_t$ - information at time t.

- Perturbation solution

$$x_t(r_t) \approx x(r_t) + T_{r_t,z}(z_t - z(r_t)) + \frac{1}{2!}\mathcal{T}_{r_t,zz}(z_t - z(r_t))^{\otimes} 2 + ...$$

  where $z_t \equiv [x'_{t-1}, \sigma, \epsilon'_t]$ – vector of state variables, σ – perturbation parameter.

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Idea of perturbation parameter

The perturbation parameter σ has the following properties:

$\sigma = 1$: system of equations is the original one
$\sigma = 0$: system of equations reduces to a tractable one

Maih and Waggoner (2018):

- if $\sigma = 0$ stochastic disturbances are eliminated
- $q_{r_t r_{t+1}} = \begin{cases} \sigma p_{r_t r_{t+1}} & r_t \neq r_{t+1}, \\ \sigma(p_{r_t r_t} - 1) + 1 & r_t = r_{t+1} \end{cases}$
  where $q_{r_t r_{t+1}}$ is the perturbed transition probability. Hence, for $\sigma = 0$, the point $x(h)$ around which the system is perturbed can be interpreted as the deterministic steady state which would prevail in regime h if it were considered in isolation.

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Simulation statistics (100,000 quarters)

	Mean	Std.Dev.(*100)	Det.StSt.
Spread (l)	0.572	0.825	0.640
Spread (h)	1.145	1.186	0.960
Leverage (l)	3.710	15.290	3.746
Leverage (h)	3.857	18.153	3.639
Output (l)	0.227	1.562	0.239
Output (h)	0.224	1.568	0.227
Consumption (l)	0.187	1.229	0.197
Consumption (h)	0.186	1.241	0.188
Labor (l)	0.088	0.500	0.093
Labor (h)	0.087	0.510	0.089
Inflation (l)	0.001	0.245	0
Inflation (h)	-0.004	0.283	0
Time in h-regime (in %)	25.471		
Mean length in quart. (l)	68.627		
Mean length in quart. (h)	23.454		
Prob. l to h (in %)	1.426		
Prob. h to l (in %)	3.069		

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Regime switch with capital buffers