Monetary policy and endogenous financial crises

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What role for financial stability in the conduct of monetary policy (MP)?

- Conventional view: central bank should focus on price stability
- Alternative (more recent) view: it should also promote financial stability
- Standard models of MP analysis ignore financial factors
- In their extensions with financial frictions, crises are modelled as exogenous extreme shocks

⇒ Existing (NK) models are ill–equipped to study how MP affects financial stability/fragility

A NK model with microfounded endogenous financial crises

- Textbook NK augmented with:
  1. Endogenous capital accumulation and global solution ⇒ protracted investment booms
  2. Idiosyncratic productivity shocks ⇒ capital reallocation through credit markets
  3. Financial frictions ⇒ occasional credit market freezes

⇒ Tradeoff between (short run) price stability and (medium run) financial stability

Selected findings

1. Systematic response to output ($\neq$ strict inflation targeting) improves welfare
2. Discretionary loose MP followed by abrupt reversal may lead to a crisis

Our model nests the textbook NK model

- Central bank, households, monopolistic retailers are as in textbook NK model
- Intermediate goods firms invest in capital, hire labor, sell goods to retailers

Intermediate goods firms

- Firms are competitive, live one period, from the end of $t-1$ until the end of t
- End of $t-1$: identical, issue same equity, purchase same capital K_t
- Beginning of t: learn idiosyncratic productivity $\omega_t(j)$, hire $N_t(j)$, and adjust capital to $K_t(j)$

$$y_t(j) = A_t(\omega_t(j)K_t(j))^{\alpha} N_t(j)^{1-\alpha}$$

- μ unproductive firms with $\omega_t(j) = 0$ and $1-\mu$ productive firms with $\omega_t(j) = 1$

Bond market — No financial frictions

- Unproductive firm chooses K_t^u:
  - $\max_{K_t^u} \quad 0 \quad + (1-\delta)K_t^u - (1+r_t^b)(K_t^u - K_t)$
  - Natural lender: sells capital ($K_t^u - K_t < 0$) and invests proceeds in bonds if $r_t^b \geq -\delta$
  - May buy capital and keep it idle if $r_t^b < -\delta$

- Productive firm chooses K_t^p and N_t^p:
  - $\max_{K_t^p, N_t^p} \frac{p_t}{P_t} A_t K_t^{p\,\alpha} N_t^{p\,1-\alpha} - \frac{W_t}{P_t} N_t^p + (1-\delta)K_t^p - (1+r_t^b)(K_t^p - K_t)$
  - Natural borrower: issues bonds and buys capital ($K_t^p - K_t > 0$) if $r_t^b \leq r_t^k \equiv \frac{p_t}{P_t}\frac{\alpha y_t^p}{K_t^p} - \delta$
  - May sell capital and invest in bonds if $r_t^b > r_t^k$

Bond market — Financial frictions

- Asymmetric Information: $\omega_t(j)$ is private information
- Limited Enforcement: firm j may borrow, buy capital, keep it idle, and default

- An unproductive firm has two options:
  1. Behave: sell capital and lend the proceeds $\rightarrow (1 + r_t^b)K_t$
  2. Misbehave: borrow and buy capital (*i.e.* mimic productive firms), and default $\rightarrow (1 - \delta)K_t^p$

Bond market — Incentive compatibility constraint

$$(1-\delta)K_t^p \le (1+r_t^b)K_t \quad \Leftrightarrow \quad K_t^p - K_t \le \frac{r_t^b+\delta}{1-\delta}K_t$$

- Productive firms' aggregate incentive–compatible loan demand <u>increases</u> with r_t^b

$$L_t^D\left(\underbrace{r_t^b}_{+}\right) = (1-\mu)\frac{r_t^b+\delta}{1-\delta}K_t$$

- Unproductive firms' aggregate loan supply is fixed

$$L_t^S\left(\underbrace{r_t^b}_{\cdot}\right) = \mu K_t$$

Bond market — Financial fragility

- Rate r_t^b must be high enough to entice every unproductive firm to lend:

$$L_t^S\Bigg(\underbrace{r_t^b}_{\cdot}\Bigg) \leq L_t^D\Bigg(\underbrace{r_t^b}_{+}\Bigg) \quad \Leftrightarrow \quad \mu K_t \leq (1-\mu)\frac{r_t^b+\delta}{1-\delta}K_t \quad \Leftrightarrow \quad r_t^b \geq \bar{r}^k \equiv \frac{\mu-\delta}{1-\mu}$$

- Rate r_t^b cannot be too high to entice productive firms to borrow:

$$r_t^b \leq r_t^k$$

⇒ The bond market collapses when the marginal return of capital is below a threshold

$$r_t^k < \bar{r}^k \quad \Leftrightarrow \quad \frac{p_t}{P_t}\frac{Y_t}{K_t} < \frac{(1-\delta)\mu}{\alpha(1-\mu)}$$

Monetary policy affects financial fragility in the short and medium term

- Probability of a crisis: $\mathbb{E}_{t-1}\left(\mathbb{1}\left\{\frac{Y_t}{\mathcal{M}_t K_t} < \frac{(1-\delta)\mu}{\alpha(1-\mu)}\right\}\right)$
- Short run: through macro–economic stabilization $\rightarrow$ Y– and M–channels
- Medium run: through savings and capital accumulation $\rightarrow$ K–channel

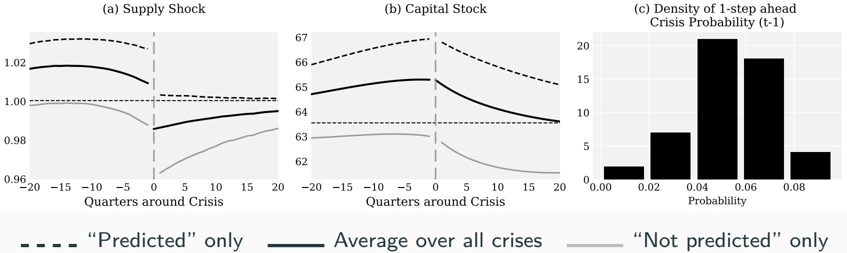
Parametrization/calibration of the model

- $\mu = 2.42\%$ $\rightarrow$ the economy spends 8% of the time in a crisis
- Monetary policy rule is Taylor (1993)'s original rule (TR93), with $\phi_\pi = 1.5$ and $\phi_y = 0.5/4$:

$$1 + i_t = \frac{1}{\beta}(1 + \pi_t)^{\phi_\pi} \left(\frac{Y_t}{\overline{Y}}\right)^{\phi_y}$$

- Experiments with strict inflation targeting ($\pi_t = 0$) and different values of ϕ_y

Most crises are endogenous and follow a credit/investment boom



- Simulate the model with TFP shocks only and focus on the dynamics around crises
- Distribution of crisis probabilities is left–skewed → crises are mostly predicted/endogenous

Finding 1: systematic response to output improves welfare upon SIT

Rule	ϕ_y	Frictionless: CEV^{SIT} (%)	Frictional bond market: CEV^{SIT} (%)	Frictional bond market: CEV^{FB} (%)	Frictional bond market: Crisis time (%)	Frictional bond market: Length (quarter)	Frictional bond market: Output loss (%)	Frictional bond market: $\mathbb{E}(\pi_t^2)$
SIT	–	–	–	-0.1114	9.85	5.91	-5.78	0.0000
Taylor rules ($\phi_\pi = 1.5$)	0.025	-0.0000	-0.0072	-0.1198	10.47	5.94	-5.75	0.0004
	0.050	-0.0001	-0.0012	-0.1137	9.87	5.80	-5.53	0.0012
	0.125	-0.0009	0.0160	-0.0964	[8.00]	5.31	-4.94	0.0064
	0.250	-0.0037	0.0415	-0.0706	5.00	4.58	-4.24	0.0200
	0.500	-0.0116	0.0652	-0.0466	1.39	3.64	-3.16	0.0516
	0.750	-0.0197	0.0649	-0.0467	0.45	4.49	-2.45	0.0817

- In the absence of financial frictions, Strict Inflation Targeting (SIT) is optimal
- Even TR93 improves welfare over SIT

Finding 1: systematic response to output improves welfare upon SIT

Rule		ϕ_y	Frictionless CEV^{SIT} (%)	Frictional bond market CEV^{SIT} (%)	CEV^{FB} (%)	Crisis time (%)	Length (quarter)	Output loss (%)	$\mathbb{E}(\pi_t^2)$
SIT		–	–	–	-0.1114	9.85	5.91	-5.78	0.0000
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- The welfare cost of crises under SIT 0.11% (Consumption Equivalent Variation)
- Even TR93 improves welfare over SIT

Finding 1: systematic response to output improves welfare upon SIT

		Frictionless	Frictional bond market					
Rule	ϕ_y	CEV^{SIT} (%)	CEV^{SIT} (%)	CEV^{FB} (%)	Crisis time (%)	Length (quarter)	Output loss (%)	$\mathbb{E}(\pi_t^2)$
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	0.750	-0.0197	0.0649	-0.0467	0.45	4.49	-2.45	0.0817

- In the presence of financial frictions, SIT is not optimal anymore
- Even TR93 improves welfare over SIT

Finding 1: systematic response to output improves welfare upon SIT

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Rule	ϕ_y	CEV^{SIT} (%)	CEV^{SIT} (%)	CEV^{FB} (%)	Crisis time (%)	Length (quarter)	Output loss (%)	$\mathbb{E}(\pi_t^2)$
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- The welfare results reflect a tradeoff between financial and price stability
- Even TR93 improves welfare over SIT

Finding 1: systematic response to output improves welfare upon SIT

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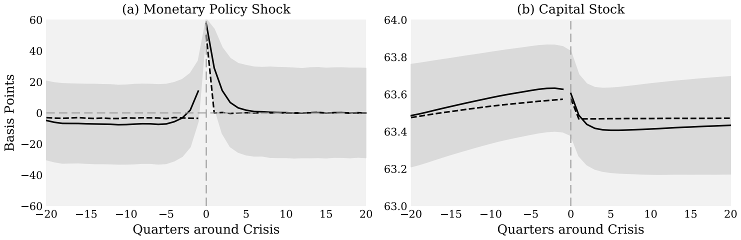
	0.750	-0.0197	0.0649	-0.0467	0.45	4.49	-2.45	0.0817

- There is a limit as to how aggressively the central bank should respond to output
- Even TR93 improves welfare over SIT

Finding 2: keeping rates too low for too long may lead to a crisis



AR(1) i.i.d. surprises

- Discretionary deviations from TR93 → simulate the model with MP shocks
- Crises occur after a "Great Deviation" (Taylor (2011)) and an abrupt rate hike

Takeaways

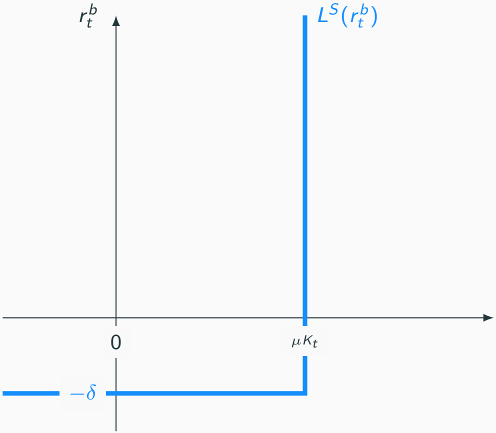
- Canonical NK model with micro–founded endogenous financial crises
- MP affects financial stability through Y–M–K channels
- Systematic response to output ($\neq$ SIT) improves welfare
- Discretionarily loose MP followed by abrupt reversal may lead to crisis
- More discussions and results in the paper:
  - Markup and savings glut externalities
  - MP as backstop to the financial sector (non–linear rules)
  - With both TFP and demand shocks

Backup Slides

Related literature

- NK models with financial frictions, with heterogenous agents
- Reduced form models of endogenous financial crises
  - Woodford (2012), Filardo and Rungcharoentkitkul (2016), Svensson (2017), Gourio, Kashyap, Sim (2018) Ajello, Laubach, Lopez–Salido, Nakata (2019), Cairo and Sim (2018)
- Micro–founded models of endogenous financial crises
  - Boissay, Collard, Smets (2016), Benigno and Fornaro (2018), Gertler, Kiyotaki, Prestipino (2019), Paul (2020)
- Evidence on financial crises and resource misallocation
  - Foster, Grim, Haltiwanger (2016), Argente, Lee, Moreira (2018), Campello, Graham, Harvey (2010)

Bond market — Frictionless case



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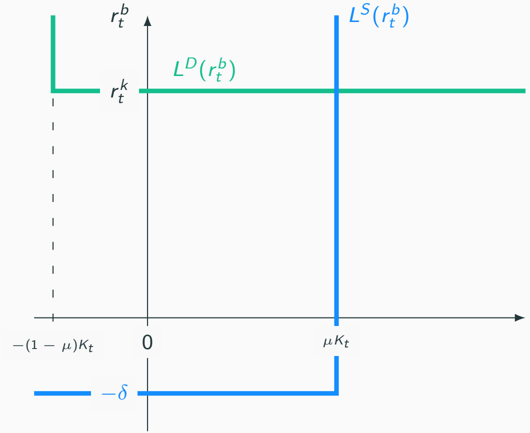
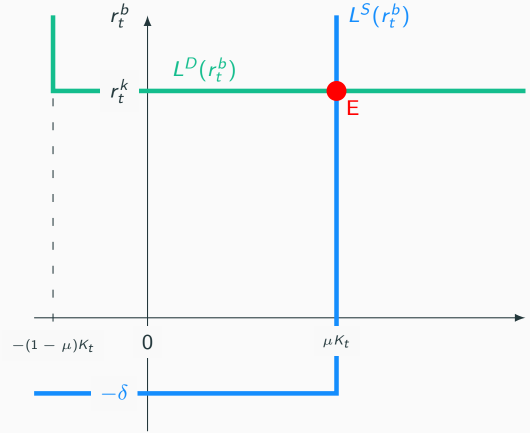


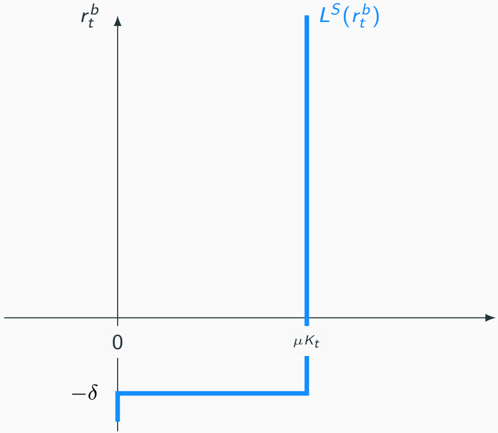
Bond market — Frictionless case



- In E, $r_t^k = r_t^b$ and capital is perfectly reallocated to productive firms:

$$\mu K_t = (1-\mu)(K_t^p - K_t)$$

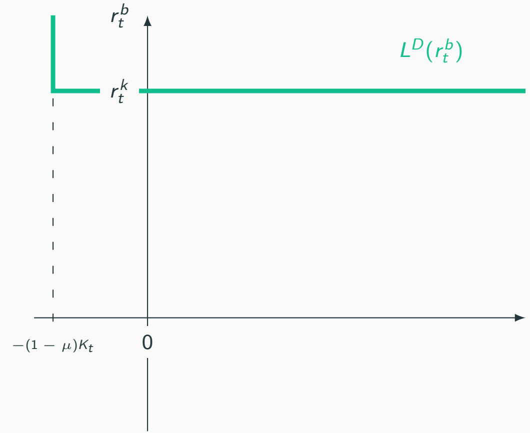
- Model boils down to the textbook NK model with one representative firm



Unproductive firms' supply:

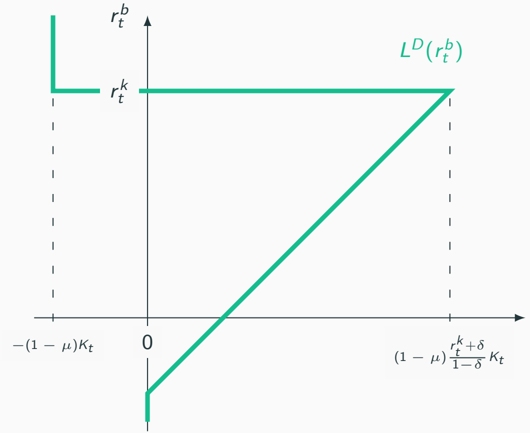
$$L^S(r_t^b) = \begin{cases} \mu K_t & \text{for } r_t^b > -\delta \\ [0, \mu K_t] & \text{for } r_t^b = -\delta \\ 0 & \text{for } r_t^b < -\delta \end{cases}$$

Bond market — Frictional case



Productive firms' demand...

Bond market — Frictional case



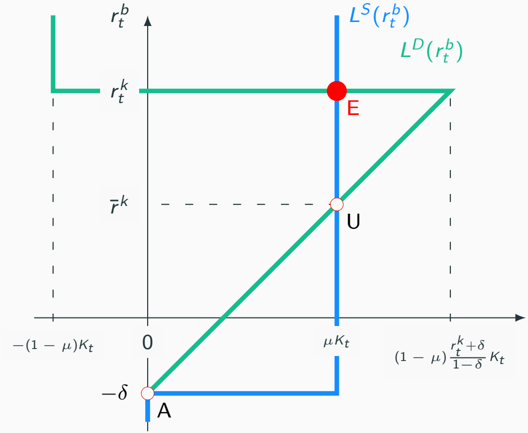
Productive firms' demand...

... now with incentive compatibility constraint

Productive firms' demand:

$$L^D(r_t^b) = \begin{cases} -(1-\mu)K_t & \text{for } r_t^b > r_t^k \\ \left[-(1-\mu)K_t, (1-\mu)\frac{r_t^k+\delta}{1-\delta}K_t\right] & \text{for } r_t^b = r_t^k \\ (1-\mu)\max\{\frac{r_t^b+\delta}{1-\delta}, 0\}K_t & \text{for } r_t^b < r_t^k \end{cases}$$

Bond market — Frictional case

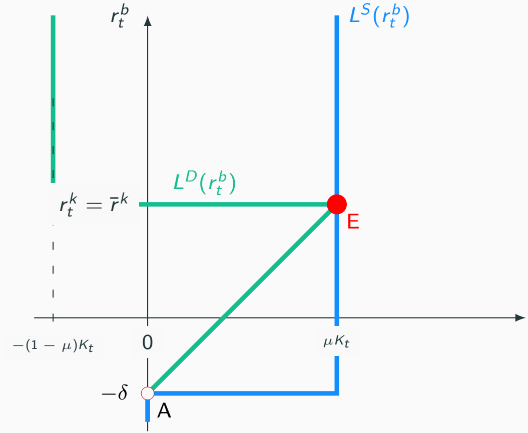


- Equilibrium E is the same as in the frictionless case and textbook model:

$$\mu K_t = (1-\mu)(K_t^p - K_t)$$

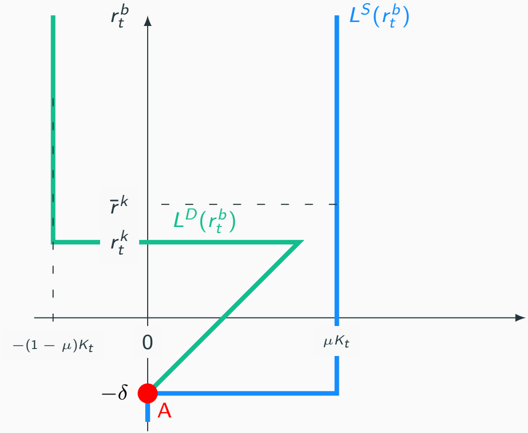
- Aggregate outcome is the same in E and U
- Absence of coordination failure rules out equilibrium A

Bond market — Frictional case



- $\bar{r}^k$ is the minimum bond rate that ensures that every unproductive firm can lend

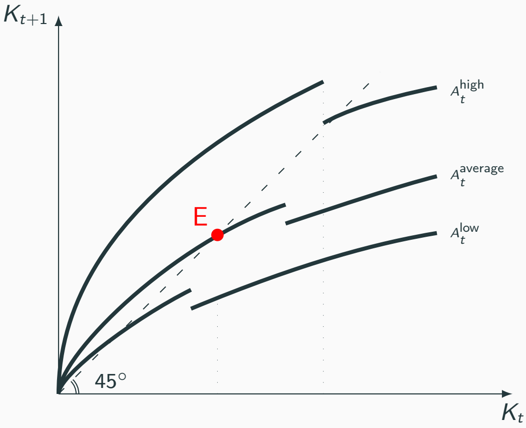
Bond market — Frictional case



- $\bar{r}^k$ is the minimum bond rate that ensures that every unproductive firm can lend
  - For $r_t^b > -\delta$, there is excess supply

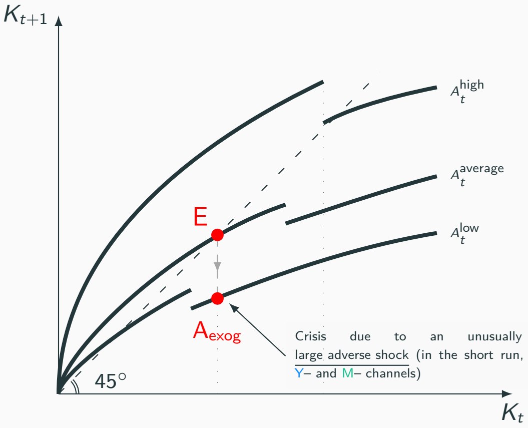
  $\rightarrow$ Unproductive firms that are left out may borrow
- No trade in A $\rightarrow$ financial crisis

Two polar types of crisis



Optimal decision rules $K_{t+1}(K_t, A_t)$

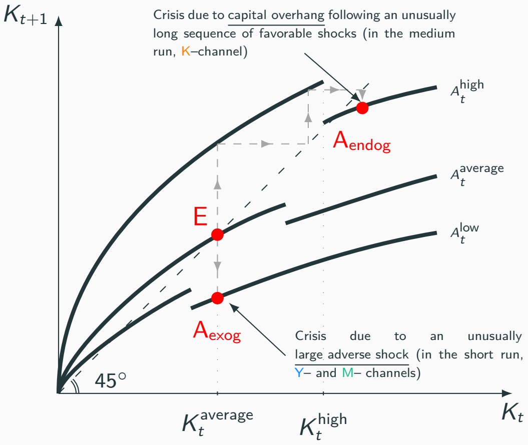
Two polar types of crisis



Optimal decision rules $K_{t+1}(K_t, A_t)$

- MP affects financial stability in the short run, *e.g.* through its effects on aggregate demand during recessions (Y– and M–channels)...

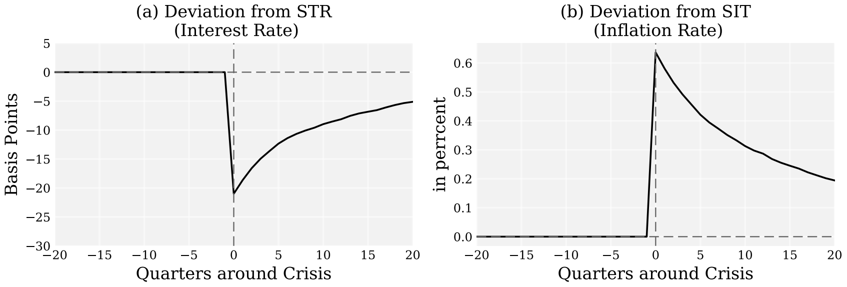
Two polar types of crisis



Optimal decision rules $K_{t+1}(K_t, A_t)$

- MP affects financial stability in the short run, *e.g.* through its effects on aggregate demand during recessions (Y– and M–channels)...
- ... and in the medium run, through its effects on capital accumulation (K–channel)

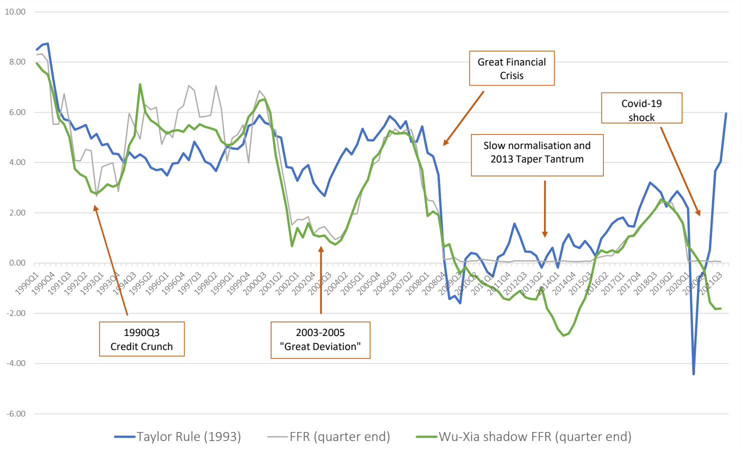
Backstop: do whatever it takes whenever needed to forestall a crisis



Backstop policies increase financial fragility but overall raise welfare

Rule	ϕ_y	CEV^{SIT} (%)	CEV^{FB} (%)	BP time (%)	Length (quarter)	$\mathbb{E}(\pi_t^2)$
SIT	–	0.1102	-0.0013	15.16	8.84	0.0019
Taylor rules ($\phi_\pi = 1.5$)	0.025	0.1103	-0.0012	17.99	9.17	0.0011
	0.050	0.1102	-0.0013	16.30	8.70	0.0017
	0.125	0.1096	-0.0019	11.81	7.45	0.0063
	0.250	0.1071	-0.0044	6.30	5.93	0.0196
	0.500	0.0998	-0.0117	1.38	4.43	0.0196
	0.750	0.0918	-0.0196	0.37	5.11	0.0821

Shadow versus Taylor–rule based Federal Fund Rates



Source: Atlanta Fed