Monetary policy and endogenous financial crises

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The views expressed here are our own and may not reflect those of the BIS
Impact of monetary policy on financial stability remains a controversial topic

- Loose monetary policy is thought to have helped stave off financial crises (e.g. 9/11 terrorist attacks, Covid–19),

- ... but also as one of the causes of the 2007–8 Great Financial Crises (e.g. Taylor (2011), Jimenez et al (2002), Grimm et al (2023))
Research questions

1. What are the channels through which monetary policy (MP) affects financial stability (FS)?

2. Should monetary policy deviate from price stability to promote financial stability?

3. To what extent may MP itself brew financial vulnerabilities?

→ Needed: models where MP affects the incidence and severity of crises
NK model with endogenous and microfounded financial crises

- Textbook New Keynesian (NK) model, with capital accumulation and sticky prices
  - Idiosyncratic productivity shocks → capital reallocation among firms via a credit market
  - Financial frictions → credit market prone to endogenous collapse when borrowers search for yield
  - Global solution → capture nonlinearities and dynamics far away from steady state

- MP is the “only game in town” (e.g. no macroprudential policy)
Main findings

1. MP affects FS both in the short run via aggregate demand, as well as in the medium run, via capital accumulation

2. By deviating from strict inflation targeting (SIT), and reacting to output and financial fragility alongside inflation, the central bank can improve both FS and welfare

3. MP can lead to a crisis if the policy rate remains too low for too long and then increases abruptly
1. Extended New–Keynesian model

2. Anatomy of financial crises

3. “Divine Coincidence” revisited

4. Monetary Policy Discretion as a Source of Financial Instability
Extended New–Keynesian model
Model– Agents

- **Central bank**: sets nominal interest rate

- **Household**: representative, works, consumes, saves (nominal bonds, firm equity)

- **Retailers**: monopolistic, diversify intermediate goods, sticky prices

- **Intermediate goods firms**: competitive, issue equity, invest, produce with labor and capital
  + **Idiosyncratic productivity shocks** → capital reallocation among firms via a credit market
Intermediate goods firms

- Continuum of 1-period firms indexed by $j \in [0, 1]$

- **End of** $t-1$: Firms are similar and all get start-up equity funding $P_{t-1}Q_{t-1}$ and purchase capital $K_t = Q_{t-1}$

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Firms' optimisation

Credit market - reallocation role
Intermediate goods firms

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- **Beginning of** $t$: firm $j$ has access to a production technology

\[ Y_t(j) = A_t(\omega_t(j)K_t(j))^\alpha N_t(j)^{1-\alpha}, \]

where $\omega_t(j) = \begin{cases} 
0 & \text{with probability } \mu \rightarrow \text{Unproductive} \\
1 & \text{with probability } 1 - \mu \rightarrow \text{Productive} 
\end{cases}$
Intermediate goods firms

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\end{cases}
\]

- Upon observing \( \omega_t(j) \), firm \( j \) may adjust its capital from \( K_t \) to \( K_t(j) \) via a credit market
Credit market

- **Asymmetric Information:** $\omega_t(j)$ is private information

- **Limited Commitment:** firm $j$ may borrow, purchase capital goods, and abscond with them in search for yield

$\Rightarrow$ Borrowing limit is the same for all firms, and credit market is fragile
Credit market equilibrium

- **Incentive Compatibility Constraint:**

An unproductive firm has two options:

1. **Behave:** sell its capital to lend the proceeds at equilibrium loan rate \( r_c^t \rightarrow (1 + r_c^t)K_t \)

2. **Misbehave:** borrow to buy more capital \( K^p_t - K_t \) (i.e. mimic productive), abscond \( \rightarrow (1 - \delta)K^p_t - \theta(K^p_t - K_t) \)
**Incentive Compatibility Constraint:**

Unproductive firms lend *iff* the equilibrium loan rate $r^c_t$ is high enough

\[
(1 + r^c_t)K_t \geq (1 - \delta)K^p_t - \theta(K^p_t - K_t)
\]

where $r^c_t$ satisfies $\mu K_t = (1 - \mu)(K^p_t - K_t)$

\[\iff r^c_t \geq \bar{r}^k \equiv \frac{(1 - \theta)\mu - \delta}{1 - \mu}\]
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- **Participation Constraint:**

  Productive firms borrow *iff* \( r^c_t \) is lower than their return on capital \( r^k_t \)

  \[
  r^c_t \leq r^k_t \equiv \frac{p_t \alpha Y^p_t}{K^p_t} - \delta = \frac{p_t \alpha Y_t}{K_t} - \delta
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Credit market

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  \]

- Trade is possible iff the marginal return on capital \( r^k_t \geq \bar{r}^k \)
Normal versus crisis times

- **Normal times:** when \( r^k_t \geq \bar{r}^k \) and firms trade on the credit market, \( r^c_t = r^k_t \geq \bar{r}^k \), capital is fully reallocated, aggregate production function is as in the credit-frictionless economy

\[ Y_t = A_t K_t^\alpha N_t^{1-\alpha} \]

- **Crisis times:** when \( r^k_t < \bar{r}^k \) and firms don’t trade on credit market, capital is not reallocated, unproductive firms keep capital idle and capital mis-allocation lowers TFP

\[ Y_t = A_t ( (1 - \mu) K_t )^\alpha N_t^{1-\alpha} \]
MP affects financial fragility in the short and medium run

- **Condition for a crisis**

\[
\frac{\alpha Y_t}{M_tK_t} \leq (1 - \tau) \left[ \frac{(1 - \theta)\mu - \delta}{1 - \mu} + \delta \right]
\]

- **Short-run:** through macro–economic stabilization

- **Medium-run:** through capital accumulation

- **Two types of polar crises**
MP affects financial fragility in the short and medium run

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- **Short-run**: through macro–economic stabilization \( \rightarrow Y - \) and \( \mathcal{M} - \)channels
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- **Short-run**: through macro-economic stabilization \(\rightarrow Y\)– and \(M\)–channels

- **Medium-run**: through capital accumulation \(\rightarrow K\)–channel
Anatomy of financial crises
Quantitative analysis

- **Quarterly parametrization.** Two non-standard parameters only:
  1. $\mu$: the share of unproductive firms set to 5% to have a productivity fall by 1.8% due to financial frictions during a crisis
  2. $\theta$: the default cost set to 0.52 to have the economy spend 10% of the time in crisis (under TR93)

- **Global solution and simulation** of the (nonlinear) model over one million periods

- **The analysis focuses on** the dynamics around financial crises and on crisis statistics
Average crisis dynamics and crisis variety under the Taylor Rule

→ Some crises break out on the back of an investment boom, others follow severe adverse non-financial shocks
The household accumulates precautionary savings in anticipation of revenue losses.

Retailers frontload price increases in anticipation of inflationary pressures.

Individual “hedging” behaviors precipitate the crisis via K– and M–channels.
The "yield gap" \((1 + r^q_t)/(1 + r^q)\) – an index of financial fragility
The price–financial stability trade–off

- Under SIT, the economy spends 9.4% in a crisis and prices are fully stable.
- Reducing the incidence of crises below 9.4%, necessarily entails deviating from price stability
- E.g.: when the central bank reacts to output, financial fragility and inflation, the incidence of crises can be lowered to 5.4%, but inflation volatility rises to 1.16 pp (in standard deviations)

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Divine coincidence

Why?

Full table
## The price–financial stability trade–off

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### Divine coincidence

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Deviating from price stability can improve welfare

- E.g.: Reacting to output and financial fragility alongside inflation can improve welfare upon SIT

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Welfare gains can be even higher under "backstop rules"

- "Backstop policy rules": state–contingent rules whereby the central bank commits to deviate from its standard rule (e.g. SIT, Taylor rule) in the face of financial stress so as to avoid crises
- Under SIT–backstop, welfare gains relative to SIT are larger than under Augmented Taylor–type Rules

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Crises are avoided under "backstop rules" with exceptionally loose policy.
Monetary Policy Discretion as a Source of Financial Instability
Discretionarily keeping rates too low for too long may lead to a crisis

- Discretionary deviations from TR93 → simulate the model with MP shocks only
- Crises occur after a “Great Deviation”...(Taylor (2011))
- ... when the central bank abruptly reverses the policy stance

Evidence Schularick et al (2021)
Discretionarily keeping rates too low for too long may lead to a crisis.

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Evidence Schularick et al (2021)

\[\text{(a) Monetary Policy Shock} \quad \text{(in percent)}\]

\[\text{(b) Capital Stock}\]

Predicted crisis \quad Average crisis \quad Unpredicted crisis
Takeaways
Takeaways

- NK model with micro-founded endogenous crises where MP affects FS via Y–M–K channels:
  - Systematic response to output and financial fragility (≠ SIT) improves both FS and welfare
  - Backstop policy effective and normalisation path depends on the nature of the stress
  - Discretionary loose MP followed by abrupt reversal may lead to crisis
APPENDIX
We study how MP affects FS in a NK model with endogenous microfounded crises

Monetary policy and financial stability (reduced form models of endogenous crises)

Micro–founded models of endogenous financial crises

Our approach: fragility of financial markets (≠ institutions) and search–for–yield behaviours (≠ collateral constraints)
Central bank

- Sets nominal interest rate $i_t$ on risk–free public bond $B_t$ according to a Taylor-type policy rule:

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

- We also experiment with alternative rules including financially–augmented Taylor rules and SIT
The representative household consumes a basket of goods $C_t$, works $N_t$, invests in a private nominal bond $B_t$ in zero net supply and in intermediate goods firm $j \in [0, 1]$’s equity $Q_t(j)$

$$\max_{C_t, N_t, B_t, Q_t(j)} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[ \frac{C_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\varphi}}{1+\varphi} \right]$$

s.t. $\int_0^1 P_t(i)C_t(i)di + B_t + P_t \int_0^1 Q_t(j)dj \leq W_t N_t + (1 + i_{t-1}^b)B_{t-1} + P_t \int_0^1 (1 + r^q_t(j))Q_{t-1}(j)dj + \Upsilon_t$

where

$$i_t^b \equiv \frac{1 + i_t}{Z_t} - 1$$

is the private bond yield, with $Z_t$ the wedge between the private yield and the policy rate $i_t$

$Z_t$ acts as an aggregate demand shock
Households’ optimality conditions:

\[
\frac{\chi N_t^p}{C_t^{-\sigma}} = \frac{W_t}{P_t}
\]

\[
1 = \beta (1 + i_t^b) \mathbb{E}_t \left[ \left( \frac{C_{t+1}}{C_t} \right)^{-\sigma} \frac{1}{1 + \pi_{t+1}} \right]
\]

\[
1 = \beta \mathbb{E}_t \left[ \left( \frac{C_{t+1}}{C_t} \right)^{-\sigma} (1 + r_{t+1}^q(j)) \right] \quad \forall j \in [0, 1]
\]

\[
Q_t(j) = Q_t \quad \forall j \in [0, 1]
\]
• Monopolistic retailer \( i \in [0, 1] \) produces a differentiated final good using intermediate goods and sets its price subject to quadratic adjustment costs à la Rotemberg (1982):

\[
\max_{P_t(i), Y_t(i)} \mathbb{E}_0 \sum_{t=0}^{\infty} \Lambda_{0,t} \left[ \frac{P_t(i)}{P_t} Y_t(i) - \frac{(1 - \tau)p_t}{P_t} Y_t(i) - \frac{\varsigma}{2} \left( \frac{P_t(i)}{P_{t-1}(i)} - 1 \right)^2 Y_t \right]
\]

s.t. \( Y_t(i) = \left( \frac{P_t(i)}{P_t} \right)^{-\epsilon} Y_t \)

where \( Y_t = C_t + I_t + \frac{\varrho}{2} Y_t \pi^2_t \), with \( I_t \equiv K_{t+1} - (1 - \delta)K_t \)

• Price setting behaviour:

\[
(1 + \pi_t)\pi_t = \mathbb{E}_t \left( \Lambda_{t,t+1} \frac{Y_{t+1}}{Y_t} (1 + \pi_{t+1})\pi_{t+1} \right) - \frac{\epsilon - 1}{\varrho} \left( \frac{\mathcal{M}_t - \mathcal{M}}{\mathcal{M}_t} \right)
\]

• Markup \( \mathcal{M}_t \equiv \frac{P_t}{(1 - \tau)p_t} \) will be important for the effect of MP on FS
Intermediate goods firms

\[
\max_{N_t(j), K_t(j)} D_t(j) = \frac{p_t}{P_t} A_t(\omega_t(j) K_t(j))^{\alpha} N_t(j)^{1-\alpha} - \frac{W_t}{P_t} N_t(j) + (1 - \delta) K_t(j) - (1 + r^c_t)(K_t(j) - K_t)
\]

Defining \( r^k_t = \frac{p_t}{P_t} \frac{\alpha Y_t(j)}{K_t(j)} - \delta = \frac{p_t}{P_t} \frac{\alpha Y_t}{K_t} - \delta \) we obtain:

- Choices of an unproductive firm \( j \) with \( \omega_t(j) = 0 \):

\[
\max_{K_t(j)} r^q_t(j) \equiv \frac{D_t(j)}{K_t} - 1 = r^c_t - (r^c_t + \delta) \frac{K_t(j)}{K_t}
\]

- Choices of a productive firm \( j \) with \( \omega_t(j) = 1 \):

\[
\max_{K_t(j)} r^q_t(j) \equiv \frac{D_t(j)}{K_t} - 1 = r^c_t + (r^k_t - r^c_t) \frac{K_t(j)}{K_t}
\]
Credit market – reallocation role:

- In the absence of credit frictions,
  
  (i) Unproductive firms sell their capital $K_t$ and lend the proceeds on the credit market: $K^u_t = 0$

  (ii) Productive firms borrow and use the funds to buy $K^p_t - K_t > 0$ additional units of capital

  ⇒ The credit market helps reallocate capital: $\mu K_t = (1 - \mu)(K^p_t - K_t)$

  ⇒ Equilibrium of the textbook NK model with a representative firm
Credit market (given $r_t^k$)

- Unproductive firms’ net loan supply

$$L^S(r_t^c) = \begin{cases} 
\mu K_t & \text{for } r_t^c > -\delta \\
(-\infty, \mu K_t] & \text{for } r_t^c = -\delta \\
-\infty & \text{for } r_t^c < -\delta
\end{cases}$$
Credit market (given $r^k_t$)

- Productive firms' net loan demand

$$L^D(r^c_t) = \begin{cases} 
-(1-\mu)K_t & \text{for } r^c_t > r^k_t \\
[-(1-\mu)K_t, +\infty) & \text{for } r^c_t = r^k_t \\
+\infty & \text{for } r^c_t < r^k_t
\end{cases}$$
Credit market (given $r_t^k$)

\[ r_t^c = r_t^k \]

\[ L^D(r_t^c) \]

\[ L^S(r_t^c) \]

- In E, $r_t^k = r_t^c$ 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.
Credit market (given $r^k_t$)

- Productive firms' net loan demand...

\[ L^D(r^c_t) = \begin{cases} - (1-\mu)K_t & \text{for } r^c_t > r^k_t \\ - (1-\mu)K_t, (1-\mu)\bar{r}k_t + \delta(1-\delta-\theta)K_t & \text{for } r^c_t = r^k_t \\ (1-\mu) \max\{r^c_t + \delta(1-\delta-\theta), 0\} K_t & \text{for } r^c_t < r^k_t \end{cases} \]

- Unproductive firms' net loan supply...

\[ L^S(r^c_t) = \begin{cases} \mu K_t & \text{for } r^c_t > -\delta \\ 0 & \text{for } r^c_t = -\delta \\ 0 & \text{for } r^c_t < -\delta \end{cases} \]
Credit market (given $r^k_t$)

- Unproductive firms’ net loan supply...
  ... now with IC constraint

$$L^S(r^e_t) = \begin{cases} 
\mu K_t & \text{for } r^e_t > -\delta \\
[0, \mu K_t] & \text{for } r^e_t = -\delta \\
0 & \text{for } r^e_t < -\delta 
\end{cases}$$
Credit market (given $r^k_t$)

- Productive firms’ net loan demand...
Credit market (given $r_t^k$)

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

- Productive firms’ net loan demand...
  ... now with IC constraint
Credit market (given $r^k_t$)

- Equilibrium E is the same as in the frictionless case and textbook model:
  \[ \mu K_t = (1 - \mu)(K^p_t - K_t) \]

- Aggregate outcome is the same in E and U

- Absence of coordination failure rules out equilibrium A
Credit market (given \( r^k_t \))

- \( \bar{r}^k \) is the minimum loan rate that ensures that all unproductive firms lend (i.e., there is no rationing)

\[
L^D(r^*_t) - \delta \quad L^S(r^*_t)
\]

\[
(1 - \mu)K_t - (1 - \mu)K_t + A
\]

\[
\bar{r}^k \text{ is the minimum loan rate that ensures that all unproductive firms lend (i.e. there is no rationing)}
\]
Credit market (given $r^k_t$)

- $\bar{r}^k$ is the minimum loan rate that ensures that all unproductive firms lend (i.e. there is no rationing)

- When $r^k_t < \bar{r}^k$, there is excess supply and every unproductive firm left out has an incentive to borrow and abscond

- In this case, $A$ (autarky) is the unique equilibrium
Perfect Information Case

- Unproductive firms do not get any loan

- Productive firm $j$'s borrowing limit is given by the incentive compatibility constraint

\[(1 - \delta)K_t(j) - \theta(K_t^P - K_t) \leq (1 + r_t^q(j))K_t = (1 + r_t^c)K_t + (r_t^k - r_t^c)K_t(j)\]

\[\iff K_t(j) - K_t \leq \frac{r_t^k + \delta}{1 - \delta - \theta + r_t^c - r_t^k}K_t\]

\[\Rightarrow L^D(r_t^c) \equiv (1 - \mu)(K_t(j) - K_t) = (1 - \mu)\frac{r_t^k + \delta}{1 - \delta - \theta + r_t^c - r_t^k}K_t \text{ if } r_t^k \geq r_t^c\]

- Aggregate loan demand monotonically decreases with $r_t^c$
Perfect Information Case

\[ L^D(r^*_t) \]

\[ L^S(r^*_t) \]

\[ -(1 - \mu)K_t \]

\[ 0 \]

\[ \frac{(1-\mu)(K^* + \delta)}{1-\delta - \theta} K_t \]

\[ \mu K_t \]

\[ -\delta \]
Two polar types of crisis

- Crises due to capital overhang following an unusually long sequence of favorable shocks
  → MP may reduce their incidence via K–channel

- Crises which break out in the face of an unusually large adverse shock
  → MP may reduce their incidence via Y– and M–channels

Optimal decision rules $K_{t+1}(K_t, A_t)$
1. \( 1 = \beta \mathbb{E}_t \left[ \frac{C_{t+1} - \sigma}{C_t - \sigma} \right] \left( \frac{1 + i_t}{1 + \pi_{t+1}} \right) \)
2. \( 1 = \beta \mathbb{E}_t \left[ \frac{C_{t+1} - \sigma}{C_t - \sigma} (1 + r^{\theta}_{t+1}) \right] \)
3. \( \chi N_t^C C_t^\sigma = \frac{\epsilon}{\epsilon - 1} \left( 1 - \alpha \right) Y_t \left( \frac{1}{M_t N_t} \right) \)
4. \( r^{\theta}_t + \delta = \frac{\epsilon}{\epsilon - 1} \frac{\alpha Y_t}{M_t K_t} \)
5. \( Y_t = C_t + X_t - \frac{\theta}{2} \pi_t^2 \)
6. \( K_{t+1} = X_t + (1 - \delta) K_t \)
7. \( Y_t = A_t (\omega_t K_t)^\alpha N_t^{1-\alpha} \)
8. \( \omega_t = \begin{cases} 1 & \text{if } r^{\theta}_t \geq \frac{\mu (1 - \theta) - \delta}{1 - \mu} \\ 1 - \mu & \text{otherwise} \end{cases} \)
9. \( (1 + \pi_t) \pi_t = \beta \mathbb{E}_t \left( \frac{C_{t+1} - \sigma}{C_t - \sigma} \right) Y_{t+1} \left( 1 + \pi_{t+1} \right) \pi_{t+1} - \frac{\epsilon - 1}{\epsilon} \left( 1 - \frac{e}{\epsilon - 1} \right) \left( \frac{1}{M_t} \right) \)
10. \( 1 + i_t = \frac{1}{\beta} (1 + \pi_t) \phi_\pi \left( \frac{Y_t}{\phi_\pi} \right) \phi_\pi \)
### Parametrisation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Target</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preferences</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta$</td>
<td>4% annual real interest rate</td>
<td>0.989</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Logarithmic utility on consumption</td>
<td>1</td>
</tr>
<tr>
<td>$\varphi$</td>
<td>Inverse Frisch elasticity equals 2</td>
<td>0.5</td>
</tr>
<tr>
<td>$\chi$</td>
<td>Steady state hours equal 1</td>
<td>0.81</td>
</tr>
<tr>
<td><strong>Technology and price setting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\alpha$</td>
<td>64% labor share</td>
<td>0.36</td>
</tr>
<tr>
<td>$\delta$</td>
<td>6% annual capital depreciation rate</td>
<td>0.015</td>
</tr>
<tr>
<td>$\varrho$</td>
<td>Same slope of the Phillips curve as with Calvo price setting</td>
<td>58.22</td>
</tr>
<tr>
<td>$\epsilon$</td>
<td>20% markup rate</td>
<td>6</td>
</tr>
<tr>
<td><strong>Aggregate TFP (supply) shocks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\rho_a$</td>
<td>Standard persistence</td>
<td>0.95</td>
</tr>
<tr>
<td>$\sigma_a$</td>
<td>Volatility of inflation and output in normal times (in %)</td>
<td>0.81</td>
</tr>
<tr>
<td><strong>Aggregate Demand shocks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\rho_Z$</td>
<td>Standard persistence</td>
<td>0.95</td>
</tr>
<tr>
<td>$\sigma_Z$</td>
<td>Volatility of inflation and output in normal times (in %)</td>
<td>0.16</td>
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<tr>
<td><strong>Interest rate rule</strong></td>
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</tr>
<tr>
<td>$\phi_\pi$</td>
<td>Response to inflation under TR93</td>
<td>1.5</td>
</tr>
<tr>
<td>$\phi_y$</td>
<td>Response to output under TR93</td>
<td>0.125</td>
</tr>
<tr>
<td><strong>Financial Frictions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\mu$</td>
<td>Productivity falls by 1.8% due to financial frictions during a crisis</td>
<td>0.05</td>
</tr>
<tr>
<td>$\theta$</td>
<td>The economy spends 10% of the time in a crisis</td>
<td>0.52</td>
</tr>
</tbody>
</table>
Anatomy of the average crisis

(a) Supply Shock

(b) Demand Shock

(c) Capital Stock

(d) Output

(e) Markup Rate

(f) Average Return on Equity

Back to main
The "Divine Coincidence" revisited

- No credit frictions: SIT eliminates simultaneously inefficient fluctuations in prices and output gap and achieves the first best allocation – "divine coincidence" (Blanchard and Galí (2007))

- Credit frictions: SIT does not deliver the first best allocation ⇒ may not be optimal anymore

Should central banks deviate from price stability to promote financial stability?

To answer this question, we study:

- The trade-off between price and financial stability

- Compare welfare under SIT with that under alternative policy rules: (i) Taylor-type rules, (ii) Taylor-type rules augmented with the yield gap, (iii) regime–contingent backstop rules
## Welfare and crisis statistics under alternative monetary policy regimes

<table>
<thead>
<tr>
<th>Rule parameters</th>
<th>Model with Financial Frictions</th>
<th>Frictionless</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time in Crisis/Stress (in %)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Length (quarters)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Output Loss (in %) (in pp)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Std((\pi_t)) Welfare Loss (in %)</td>
<td>Welfare Loss (in %)</td>
</tr>
<tr>
<td>Rule type</td>
<td>(\phi_\pi) (\phi_y) (\phi_r)</td>
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</tr>
<tr>
<td>Standard Taylor-type Rules</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) 1.5 0.125 –</td>
<td>[10] 4.8 6.6 1.2</td>
<td>0.82 0.56</td>
</tr>
<tr>
<td>(2) 1.5 0.250 –</td>
<td>7.2 4.0 5.4 1.8</td>
<td>1.48 1.21</td>
</tr>
<tr>
<td>(3) 1.5 0.375 –</td>
<td>4.1 3.1 4.4 2.5</td>
<td>3.10 2.07</td>
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<tr>
<td>(4) 2.0 0.125 –</td>
<td>9.7 5.0 7.2 0.6</td>
<td>0.41 0.17</td>
</tr>
<tr>
<td>(5) 2.5 0.125 –</td>
<td>9.6 5.1 7.5 0.5</td>
<td>0.31 0.08</td>
</tr>
<tr>
<td>SIT</td>
<td>+(\infty) – –</td>
<td>9.4 5.1 8.1 0</td>
</tr>
<tr>
<td>Augmented Taylor-type Rules</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(7) 1.5 0.125 5.0</td>
<td>5.4 3.9 5.5 1.16</td>
<td>0.65 –</td>
</tr>
<tr>
<td>(8) 5.0 0.125 5.0</td>
<td>8.8 5.0 7.4 0.18</td>
<td>0.22 –</td>
</tr>
<tr>
<td>(9) 5.0 0.125 25.0</td>
<td>6.9 4.7 6.6 0.19</td>
<td>0.18 –</td>
</tr>
<tr>
<td>(10) 10.0 0.125 75.0</td>
<td>6.3 4.6 6.4 0.09</td>
<td>0.16 –</td>
</tr>
<tr>
<td>Backstop Rules</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(11) 1.5 0.125 –</td>
<td>15.5 – – 1.21</td>
<td>0.56 –</td>
</tr>
<tr>
<td>(12) +(\infty) – –</td>
<td>17.1 – –</td>
<td>0.50 0.10</td>
</tr>
</tbody>
</table>
Why do Taylor rules improve FS over SIT?

- **Short run:** The Taylor–type rules cushion better the fall in \( r_t^k \) in the face of adverse shocks
"Backstop rules" and normalisation paths

(a) Deviation from TR93

(b) Deviation from SIT

(Annualized Inflation Rate)

- Predicted stress
- Average stress
- Unpredicted stress
Deviation from Taylor (1993) rule and shadow policy rate

Source: Federal Reserve Bank of Atlanta
Effect on annual crisis probability of an unexpected 1 pp policy rate hike

[Graphs showing the annual crisis probability effect of a 1 percentage point policy rate increase, with pointwise 95 percent confidence intervals. The full sample panel depicts the non-state-dependent effect. The other three panels depict the state-dependent effects during credit and asset price booms. Boom episodes are defined on the basis of a one-sided HP filter with smoothing parameter equal to 100.]

“Based on the near-universe of advanced economy financial cycles since the nineteenth century, we show that discretionary leaning against the wind policies during credit and asset price booms are more likely to trigger crises than prevent them”.