Monetary policy and endogenous financial crises

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Motivation

▶ **Debate on the role of financial stability (FS) in the conduct of monetary policy (MP)**

- **Conventional view**: MP should focus on price stability, and disregard FS risks
- **Alternative (more recent) view**: MP should also take FS risks into account

$\rightarrow$ **Needed:** models where MP affects the incidence and severity of crises

This paper

▶ **NK model with endogenous and microfounded financial crises**

- New Keynesian (NK) model with capital accumulation and sticky prices à la Rotemberg (1982)
    - \+ Idiosyncratic productivity shocks → capital reallocation among firms via a credit market
    - \+ Financial frictions → credit market prone to endogenous collapse if capital return is low
    - \+ Global solution → capture nonlinearities and dynamics far away from steady state
- Narrative told in terms of inter-firm lending, but could also be told in terms of bank lending
- MP is the only "game in town"

Main findings

1. Monetary policy affects financial stability
    - in the short run, via aggregate demand
    - in the medium run, via capital accumulation
2. Reacting to output and inflation improves FS and welfare upon strict inflation targeting
3. MP can lead to a crisis if the policy rate remains too low for too long and then increases abruptly

◂ Related literature

An extended New–Keynesian Model

Model– Agents

- **Central bank**: sets nominal interest rate according to $1 + i_t = \frac{1}{\beta}(1 + \pi_t)^{\phi_\pi} \left(\frac{Y_t}{\bar{Y}}\right)^{\phi_y}$
- **Household**: representative, works, consumes, saves (nominal bonds, firm equity) Household
- **Retailers**: monopolistic, diversify intermediate goods, sticky prices Retailers
- **Intermediate goods firms**: competitive, raise equity, invest, produce with labor and capital

  $+$ Idiosyncratic productivity shocks $\rightarrow$ capital reallocation among firms via a credit market

Intermediate goods firms

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

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- **End of** $t-1$: all firms get start–up equity funding $P_{t-1}Q_{t-1}$ and purchase capital $K_t = Q_{t-1}$
- **Beginning of** t: firm j has access to production technology

$$Y_t(j) = A_t(\omega_t(j)K_t(j))^{\alpha}N_t(j)^{1-\alpha}, \quad \text{where } \omega_t(j) = \begin{cases} 0 & \text{with probability } \mu \rightarrow \text{Unproductive} \\ 1 & \text{with probability } 1-\mu \rightarrow \text{Productive} \end{cases}$$

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- Upon observing $\omega_t(j)$, firm j adjusts capital from K_t to $K_t(j)$ via a credit market
- No financial frictions: capital always fully reallocated $\Rightarrow$ NK model with representative firm

- Asymmetric Information: $\omega_t(j)$ is private information
- Limited Commitment: firm j may borrow, and abscond

$\Rightarrow$ Borrowing limit identical for all firms, and fragile credit market

◂ Limited commitment only

- **Participation Constraint:**

  Productive firms borrow iff r_t^c is lower than their return on capital r_t^k

$$r_t^c \leqslant r_t^k \equiv \frac{p_t}{P_t}\frac{\alpha Y_t^p}{K_t^p} - \delta = \frac{p_t}{P_t}\frac{\alpha Y_t}{K_t} - \delta$$

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- **Incentive Compatibility Constraint:**

  An unproductive firm has two options:

  1. **Behave:** sell its capital to lend the proceeds at equilibrium loan rate $r_t^c \rightarrow (1 + r_t^c)K_t$
  2. **Misbehave:** borrow to buy capital (*i.e.* mimic productive firms) and abscond $\rightarrow (1 - \delta)K_t^p$

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- **Incentive Compatibility Constraint:**

  Unproductive firms lend *iff* the equilibrium loan rate r_t^c is high enough

$$\rightarrow \begin{cases} (1+r_t^c)K_t \geqslant (1-\delta)K_t^p \\ \text{where } r_t^c \text{ s.t. } \mu K_t = (1-\mu)(K_t^p - K_t) \end{cases} \leftrightarrow \quad r_t^c \geqslant \bar{r}^k \equiv \frac{\mu - \delta}{1-\mu}$$

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→ Trade is possible iff the marginal return on capital $r_t^k \geq \bar{r}^k$

◂ Credit market equilibrium

Normal versus crisis times

- **Normal times:** when $r_t^k \geq \bar{r}^k$ and firms trade on the credit market, $r_t^c = r_t^k \geq \bar{r}^k$, 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 $r_t^k < \bar{r}^k$ and firms don't trade on credit market, capital is not reallocated, unproductive firms keep capital idle and capital mis–allocation lowers TFP

$$Y_t = A_t \left((1-\mu) K_t\right)^{\alpha} N_t^{1-\alpha}$$

Equations of the model

MP affects financial fragility in the short and medium run

- **1-step ahead probability of a crisis:**

$$\mathbb{E}_{t-1}\left[\mathbb{1}\left(\frac{\alpha Y_t}{\mathcal{M}_t K_t} \leqslant \frac{(1-\tau)(1-\delta)\mu}{(1-\mu)}\right)\right]$$

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- **Short-run:** through macro–economic stabilization → Y– and $\mathcal{M}$–channels

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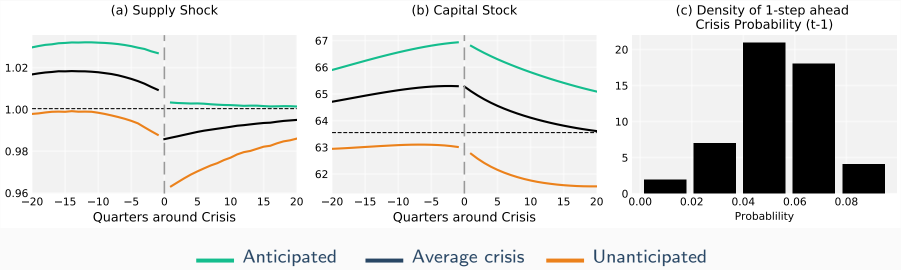
- **Short-run:** through macro–economic stabilization → Y– and $\mathcal{M}$–channels

- **Medium-run:** through capital accumulation → K–channel

Two polar crises

Anatomy of financial crises

Average crisis and crisis heterogeneity



- Parameterized s.t. the economy spends 8% of the time in crises under TR [1993].

→ **Most crises** break out on the back of an **investment boom**

→ **Few crises** follow **severe adverse** TFP shocks

◂ Parametrization ◂ Paths TFP shocks ◂ Paths TFP and demand shocks ◂ Paths demand shocks ◂ Externalities

Should MP deviate from price stability to foster FS?

Yes, responding to both output and inflation (e.g. TR93) ...

		Frictionless	Frictional credit market			
Rule	ϕ_y	Welfare Loss CEV (%)	Welfare Loss CEV (%)	Crisis time (%)	Output loss (%)	$\mathbb{E}(\pi_t^2)$
SIT	–	0	0.1114	9.85	-5.78	0.0000
TR93	0.125	0.0009	0.0964	8.00	-4.94	0.0064

→ reduces the time spent in crises (and the severity of crises) at the cost of price instability

→ increases welfare

◂ Full table ◂ FS gains in short– and medium–run ◂ Price–financial stability tradeoff ◂ TFP and AD shocks ◂ AD shocks ◂ Output loss during GFC

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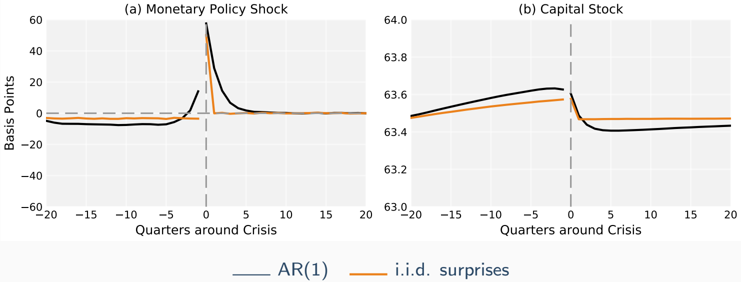
Can MP by itself lead to crises?

Yes, 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))
- ... and an abrupt rate hike Schularick et al (2021)

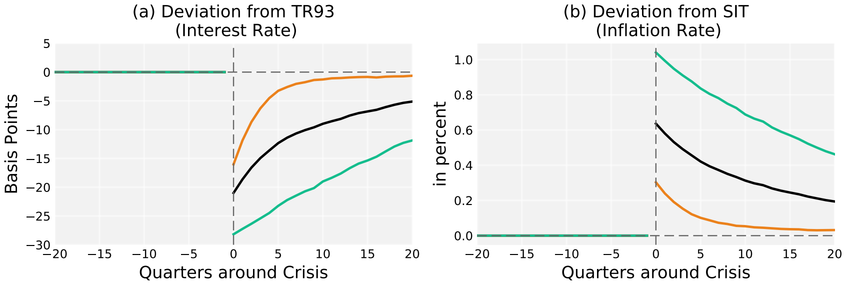
Takeaways

Takeaways

- "Canonical" NK model with micro–founded endogenous financial crises:
  - → Monetary policy **affects** financial stability via **Y–M–K channels**
  - → Systematic response to output ($\neq$ SIT) **improves** both **financial stability** and **welfare**
  - → **Discretionary loose MP** followed by **abrupt reversal** may lead to **crisis**
- Future extensions (distinct papers): ZLB and macroprudential policy

APPENDIX

Exceptionally loose MP staves off financial crises



Average crisis Anticipated Unanticipated

Welfare

Contribution to the literature

- We study how MP affects FS in NK model with endogenous microfounded crises
- Bridges two strands of literature
  - Monetary policy and financial stability (reduced form models of endogenous crises)
    Woodford (2012), Filardo and Rungcharoentkitkul (2016), Svensson (2017), Gourio, Kashyap, Sim (2018), Ajello, Laubach, Lopez–Salido, Nakata (2019), Cairo and Sim (2018), Borio, Disyatat and Rungcharoentkitkul (2019)
  - Micro–founded models of endogenous financial crises
    Boissay, Collard, Smets (2016), Benigno and Fornaro (2018), Gertler, Kiyotaki, Prestipino (2019) Market finance
- Also related to NK models with heterogenous agents, factor misallocation in financial crises

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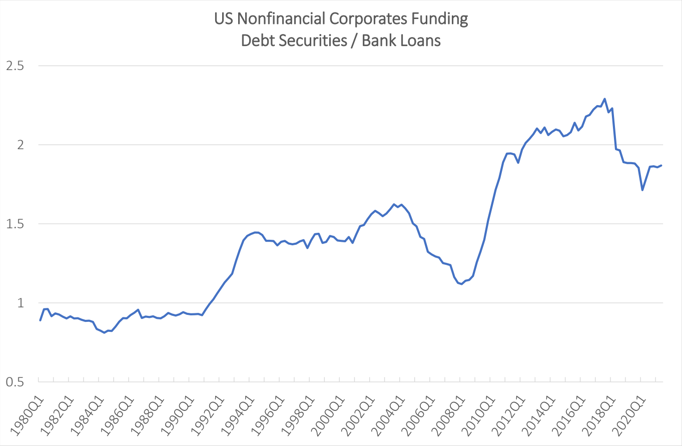
Market finance is almost twice as large as bank finance (US NFCs)



Source: US financial accounts (FED)

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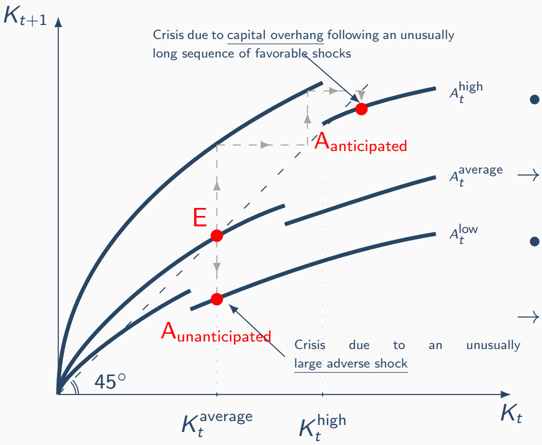
Two polar types of crisis



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

- Crises due to capital overhang following an unusually long sequence of favorable shocks

$\rightarrow$ **MP may reduce their incidence via K–channel**

- Crises which break out in the face of an unusually large adverse shock

$\rightarrow$ **MP may reduce their incidence via Y– and M–channels**

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Representative household

The representative household consumes a basket of goods C_t, works N_t, invests in public bonds B_t and in intermediate goods firm $j \in [0,1]$'s equity $P_t Q_t(j)$

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

$$\text{s.t.} \int_0^1 P_t(i) C_t(i) di + B_t + P_t \int_0^1 Q_t(j) dj \leq W_t N_t + (1+i_{t-1}) B_{t-1} + P_t \int_0^1 D_t(j) dj + \mathcal{X}_t$$

$$\begin{aligned} W_t / P_t &= \chi C_t^{\sigma} N_t^{\varphi} \\ C_t(i) &= (P_t(i)/P_t)^{-\epsilon} C_t \\ 1 &= \beta(1+i_t) \mathbb{E}_t \left\{ (C_{t+1}/C_t)^{-\sigma} (1/(1+\pi_{t+1})) \right\} \\ 1 &= \beta \mathbb{E}_t \left\{ (C_{t+1}/C_t)^{-\sigma} (1 + r_{t+1}^q(j)) \right\} \quad \forall j \in [0,1] \end{aligned}$$

where $C_t \equiv \left[\int_0^1 C_t(i)^{1-\frac{1}{\epsilon}} di \right]^{\frac{\epsilon}{\epsilon-1}}$, $\pi_{t+1} \equiv \frac{P_{t+1}}{P_t} - 1$ and $1 + r_{t+1}^q(j) \equiv \frac{D_{t+1}(j)}{Q_t(j)}$

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Retailers

Monopolistic retailer $i \in [0,1]$ produces a differentiated final good using intermediate goods and sets its price subject to quadratic adjustment costs

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

$$\text{s.t.} \quad Y_t(i) = \left(\frac{P_t(i)}{P_t} \right)^{-\epsilon} (C_t + I_t) \quad \text{where } I_t \equiv K_{t+1} - (1-\delta)K_t$$

→ Price setting behavior

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

where $\mathcal{M}_t = \frac{P_t}{(1-\tau)p_t}$ denotes the markup rate and $\mathcal{M} \equiv \frac{\epsilon}{\epsilon - 1}$ its steady state. Markup $\mathcal{M}_t$ will be important for the effect of MP on FS

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Intermediate goods firms

$$\max_{N_t(j),K_t(j)} D_t(j) = \frac{p_t}{P_t} A_t(\omega_t(j) K_t(j))^{\alpha} N_t(j)^{1-\alpha} - \frac{W_t}{P_t} N_t(j) + (1-\delta) K_t(j) - (1 + r_t^c)(K_t(j) - K_t)$$

Defining $r_t^k = \frac{p_t}{P_t} \frac{\alpha y_t(j)}{K_t(j)} = \frac{p_t}{P_t} \frac{\alpha Y_t}{K_t}$ we obtain:

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

$$\max_{K_t(j)} r_t^q(j) \equiv \frac{D_t(j)}{K_t} - 1 = r_t^c - (r_t^c + \delta) \frac{K_t(j)}{K_t}$$

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

$$\max_{K_t(j)} r_t^q(j) \equiv \frac{D_t(j)}{K_t} - 1 = r_t^c + \left(r_t^k - r_t^c\right) \frac{K_t(j)}{K_t}$$

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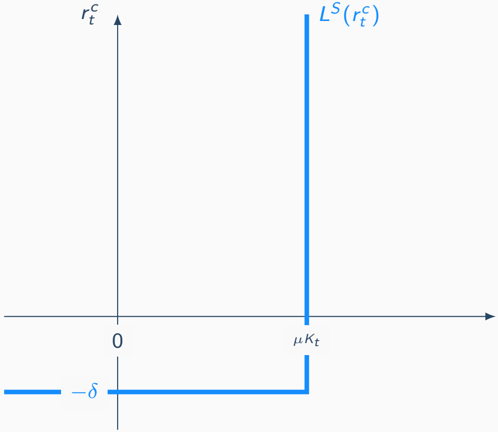


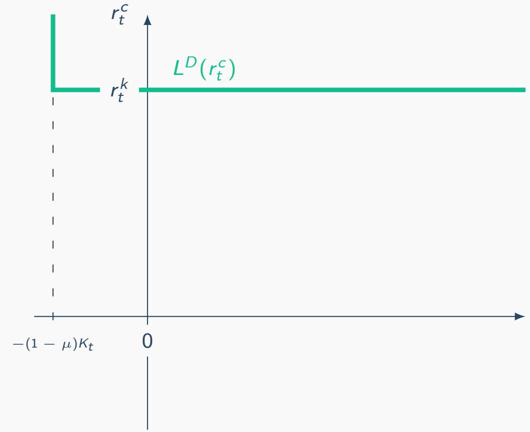
- Unproductive firms' net loan supply

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

◂ Back to main

Credit market (given r_t^k)

▶ Frictionless case



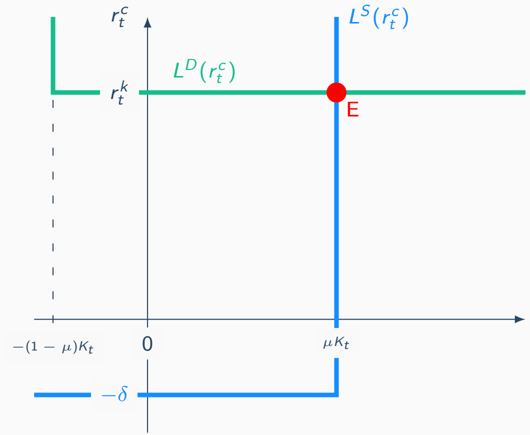
- Productive firms' net loan demand

$$L^D(r_t^b) = \begin{cases} -(1-\mu)K_t & \text{for } r_t^c > r_t^k \\ [-(1-\mu)K_t, +\infty) & \text{for } r_t^c = r_t^k \\ +\infty & \text{for } r_t^c < r_t^k \end{cases}$$

Back to main

Credit market (given r_t^k)

▶ Frictionless case



- 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

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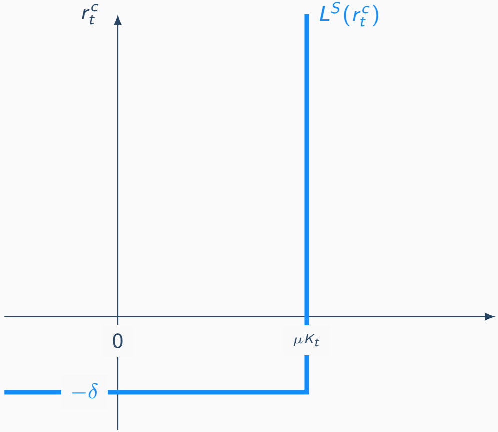
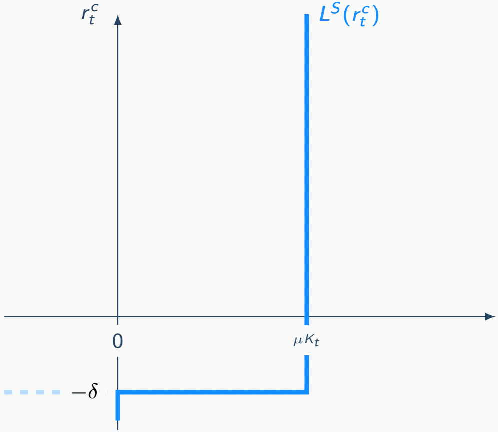
Credit market (given r_t^k)

▶ **Frictional case**



- Unproductive firms' net loan supply...

◂ Back to main



- Unproductive firms' net loan supply...

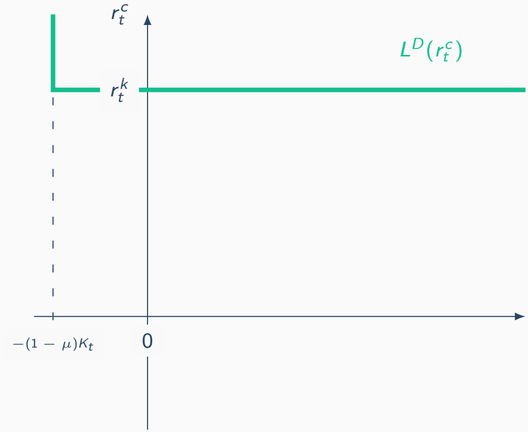
  ... now with IC constraint

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

Back to main

Credit market (given r_t^k)

- Frictional case



- Productive firms' net loan demand...

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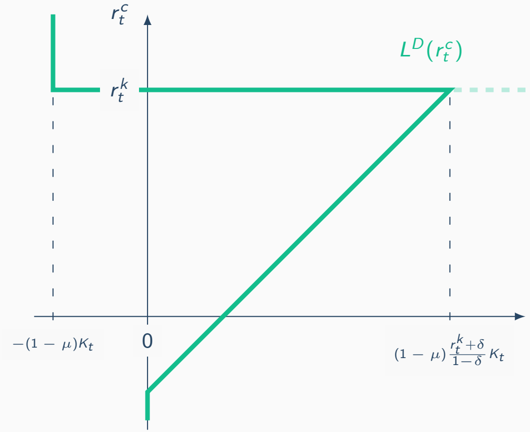
Credit market (given r_t^k)

▶ **Frictional case**



- Productive firms' net loan demand...

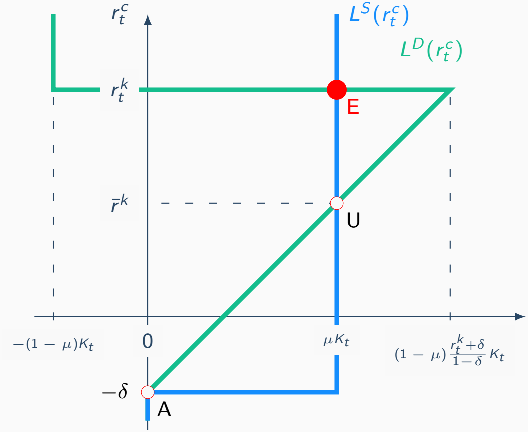
  ... now with IC constraint

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

◂ Back to main

Credit market (given r_t^k)

▶ **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

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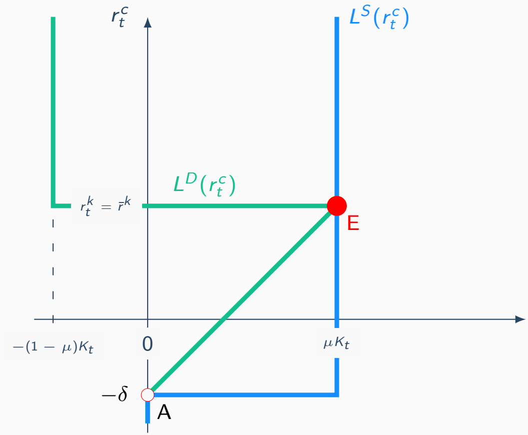
Credit market (given r_t^k)

▶ **Frictional case**



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

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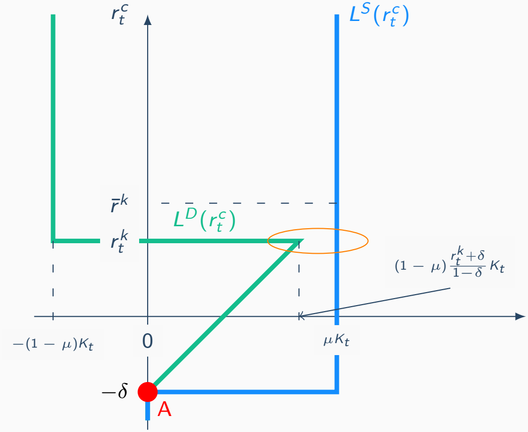

- $\bar{r}^k$ is the minimum loan rate that ensures that all unproductive firms lend (i.e. there is no rationing)
- When $r_t^k < \bar{r}^k$, there is excess supply and every unproductive firm left out has an incentive to borrow and abscond
- In this case, A (autarky) is the unique equilibrium

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Perfect Information Case

▶ Incentive Compatibility Constraint

- Unproductive firms do not get any loan
- Productive firm js' borrowing limit is given by the incentive compatibility constraint

$$(1-\delta)K_t(j) \leq (1+r_t^q(j))K_t = (1+r_t^c)K_t + \left(r_t^k - r_t^c\right) K_t(j)$$

$$\Leftrightarrow K_t(j) - K_t \leq \frac{r_t^k + \delta}{1-\delta+r_t^c-r_t^k} K_t$$

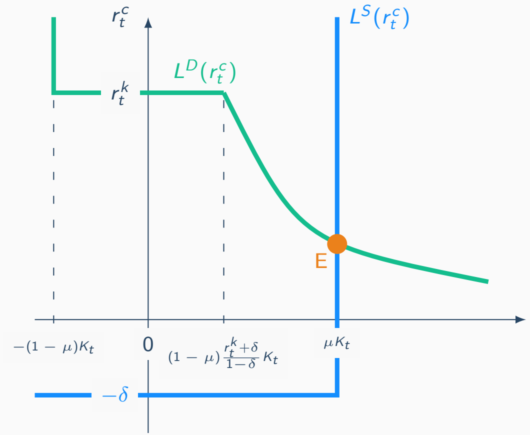
$$\Rightarrow L^D(r_t^c) \equiv (1-\mu)(K_t(j)-K_t) = (1-\mu)\frac{r_t^k+\delta}{1-\delta+r_t^c-r_t^k} K_t \ \text{ if } r_t^k \geq r_t^c$$

- Aggregate loan demand monotonically decreases with r_t^c

◂ Back to main

Perfect Information Case

▶ **Credit Market Equilibrium (given r_t^k)**



Recap of the model

1. $$1 = \mathbb{E}_t\left[\Lambda_{t,t+1}(1 + r_{t+1})\right]$$
2. $$1 = \mathbb{E}_t\left[\Lambda_{t,t+1}(1 + r^k_{t+1})\right]$$
3. $$\frac{W_t}{P_t} = \chi N_t^{\varphi} C_t^{\sigma}$$
4. $$K_{t+1} = I_t + (1-\delta)K_t$$
5. $$\frac{W_t}{P_t} = \frac{\epsilon}{\epsilon-1}\frac{(1-\alpha)Y_t}{\mathcal{M}_t N_t}$$
6. $$r_t^k + \delta = \frac{\epsilon}{\epsilon-1}\frac{\alpha Y_t}{\mathcal{M}_t K_t}$$
7. $$1 + i_t = \frac{1}{\beta}(1+\pi_t)^{\phi_\pi}\left(\frac{Y_t}{Y}\right)^{\phi_y}$$
8. $$Y_t = C_t + I_t$$
9. $$\Lambda_{t,t+1} \equiv \beta\frac{C_{t+1}^{-\sigma}}{C_t^{-\sigma}}$$
10. $$1 + r_t = \frac{1+i_{t-1}}{1+\pi_t}$$
11. $$Y_t = A_t\left(\omega_t K_t\right)^{\alpha} N_t^{1-\alpha}$$
12. $$\omega_t = \begin{cases} 1 & \text{if } r_t^k \geq \frac{\mu-\delta}{1-\mu} \\ 1-\mu & \text{otherwise} \end{cases}$$
13. $$(1+\pi_t)\pi_t = \mathbb{E}_t\left(\Lambda_{t,t+1}\frac{Y_{t+1}}{Y_t}(1+\pi_{t+1})\pi_{t+1}\right) - \frac{\epsilon-1}{\varrho}\left(1 - \frac{\epsilon}{\epsilon-1}\cdot\frac{1}{\mathcal{M}_t}\right)$$

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Quantitative analysis

- **Quarterly parametrization**. The only non–standard parameter is the share of unproductive firms. $\mu = 2.42\%$ to have the economy spend 8% of the time in crisis (with TR93 as baseline) ◂ Values

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

- **Study the dynamics 20 quarters around the beginning of a crisis**. Baseline analysis with technology shocks only. Conclusions hold with both technology and demand shocks

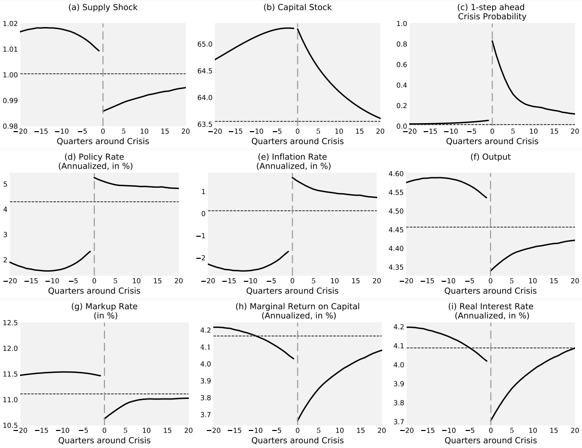
Parametrisation

Parameter	Target	Value
Preferences		
β	4% annual real interest rate	0.989
σ	Logarithmic utility on consumption	1.000
φ	Inverse Frish elasticity equals 2	0.500
χ	Steady state hours equal 1	0.814
Technology and price setting		
α	64% labor share	0.360
δ	6% annual capital depreciation rate	0.015
ϱ	Same slope of the Phillips curve as with Calvo price setting	105.000
ϵ	11% markup rate	10.000
Aggregate TFP shocks		
ρ_a	Persistence	0.950
σ_a	Standard deviation of innovations (in %)	0.700
Interest rate rule		
ϕ_π	Standard quarterly Taylor rule	1.500
ϕ_y		0.125
Proportion of unproductive firms		
μ	The economy spends 8% of the time in a crisis	2.42%

TFP and Demand shocks Back to main

Anatomy of the average crisis

▶ Technology shocks



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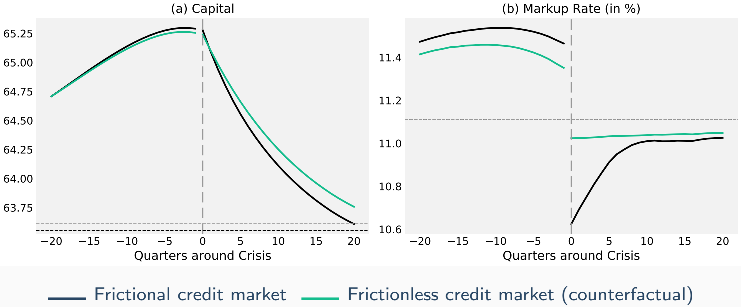
“Precautionary savings” and “markup” externalities

▶ The case for policy intervention



- The household accumulates precautionary savings in anticipation of revenue losses
- Retailers frontload price increases in anticipation of inflationary pressures

$\Rightarrow$ Individual “hedging” behaviors precipitate the crisis via K– and M–channels

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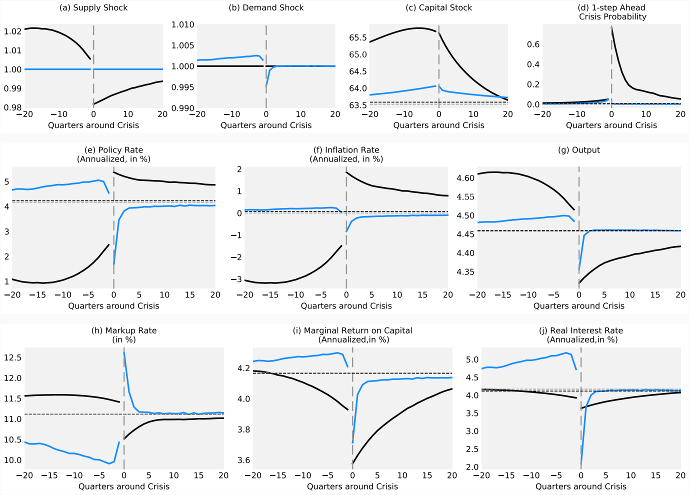
Anatomy of the average crisis

▶ Technology versus demand shocks



Model with TFP shocks only   Model with demand shocks only

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Should the central bank deviate from SIT to foster FS?

		Frictionless	Frictional credit market				
Rule	ϕ_y	Welfare Loss CEV (%)	Welfare Loss CEV (%)	Crisis time (%)	Length (quarter)	Output loss (%)	$\mathbb{E}(\pi_t^2)$
SIT	–	0	0.1114	9.85	5.91	-5.78	0.0000
Taylor rules ($\phi_\pi = 1.5$)	0.025	0.0000	0.1198	10.47	5.94	-5.75	0.0004
	0.050	0.0001	0.1137	9.87	5.80	-5.53	0.0012
	0.125	0.0009	0.0964	[8.00]	5.31	-4.94	0.0064
	0.250	0.0037	0.0706	5.00	4.58	-4.24	0.0200
	0.500	0.0116	0.0466	1.39	3.64	-3.16	0.0516
	0.750	0.0197	0.0467	0.45	4.49	-2.45	0.0817

Back to main

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AS and AD shocks

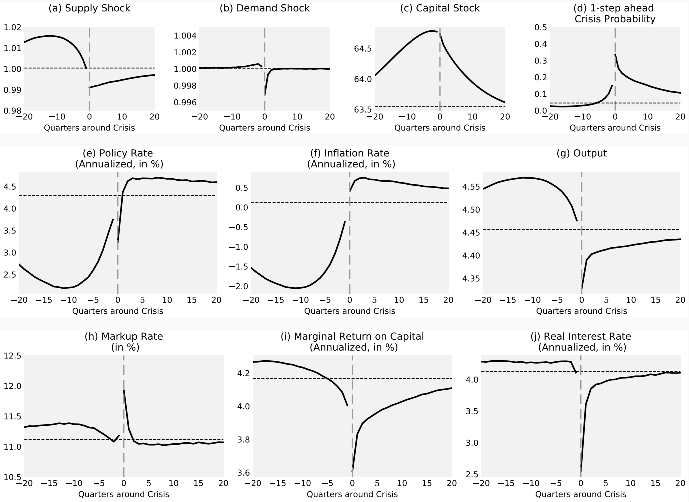
▶ Parametrization

Parameter	Target	Value
Aggregate risk–premium shocks		
ρ_z	As in Smets and Wouters (2007)	0.220
σ_z		0.230
Proportion of unproductive firms		
μ	The economy spends 8% of the time in a crisis	2.39%

◂ Back to parametrization

AS and AD shocks

▶ Anatomy of the average crisis



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With AS and AD shocks

- **Crisis statistics**

	Crisis time (%)	Output loss (%)
Economy with both shocks	[8.00]	-3.20
Economy with TFP shocks only	3.42	-4.76
Economy with demand shocks only	0.00	-2.90

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AS and AD shocks

▶ Welfare

Rule	ϕ_y	Frictionless: Welfare loss CEV^{FB}(%)	Frictional credit market: Welfare loss CEV^{FB} (%)	Crisis time (%)	Length (quarter)	Output loss (%)	$\mathbb{E}(\pi_t^2)$
SIT	–	0	0.1114	9.85	5.91	-5.78	0.0000
Taylor rules ($\phi_\pi = 1.5$)	0.025	0.0116	0.1566	13.11	1.75	-4.06	0.0006
	0.050	0.0093	0.1396	11.74	1.77	-3.77	0.0014
	0.125	0.0062	0.0980	[8.00]	1.78	-3.20	0.0065
	0.250	0.0064	0.0583	3.93	1.75	-2.71	0.0200
	0.500	0.0126	0.0298	0.46	1.46	-2.10	0.0524
	0.750	0.0203	0.0337	0.04	1.18	-1.53	0.0834

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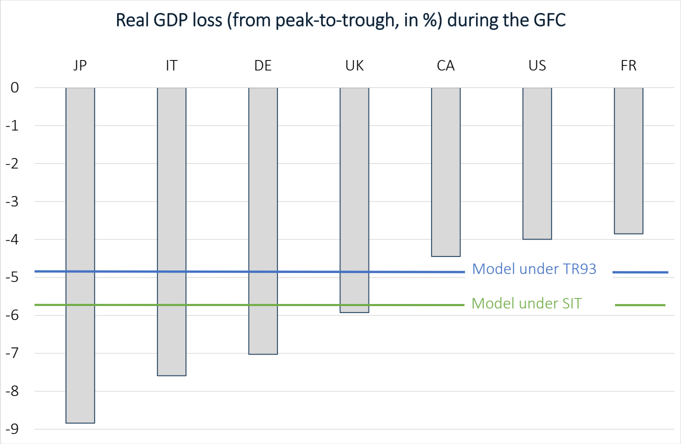
Peak–to–trough GDP fall during the GFC

▶ A success of the model



Source: FRED

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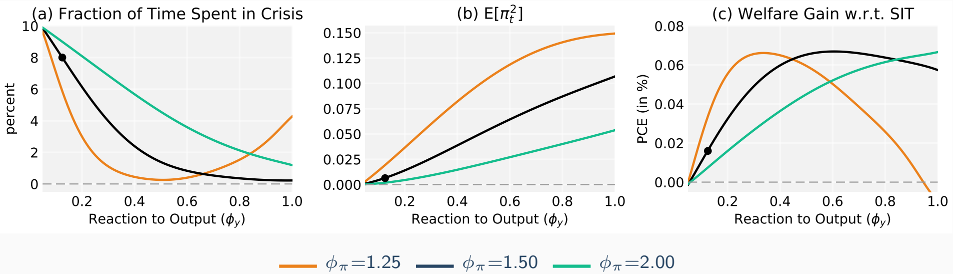
Financial stability–price stability tradeoff

▶ Conventional parameter space



- One may reduce the time spent in crisis and improve welfare upon SIT by responding systematically to output fluctuations alongside inflation
- Marginal welfare gain decreases with ϕ_y and may be come negative: beyond a certain threshold, leaning does not foster financial stability and leads to higher price volatility

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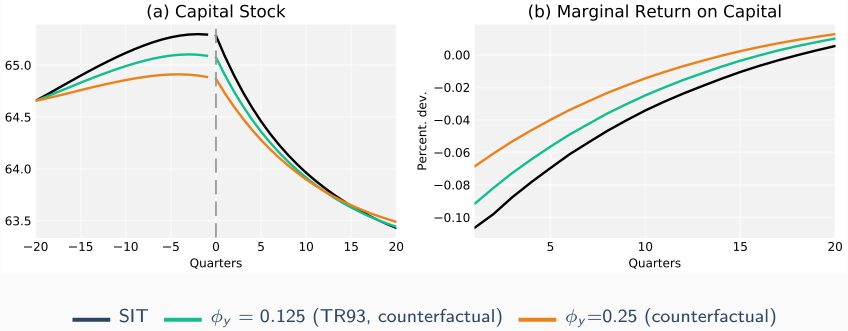
Why is there fewer crises under TR93?

▶ **A counterfactual experiment**

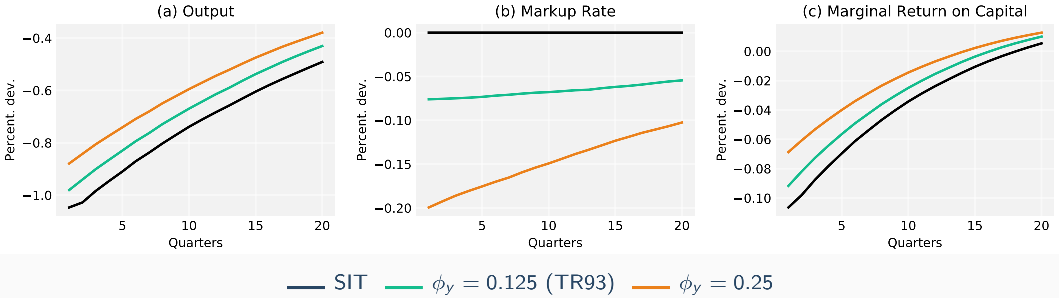


- **Medium run:** capital builds up more slowly under TR93 than under SIT
- **Short run:** TR93 cushions better the fall in MRK, r_t^k, in the face of adverse shocks

◂ IRFs ◂ Back to main

Short Run Effects

▶ **Impulse Response Function to a Negative TFP shock**

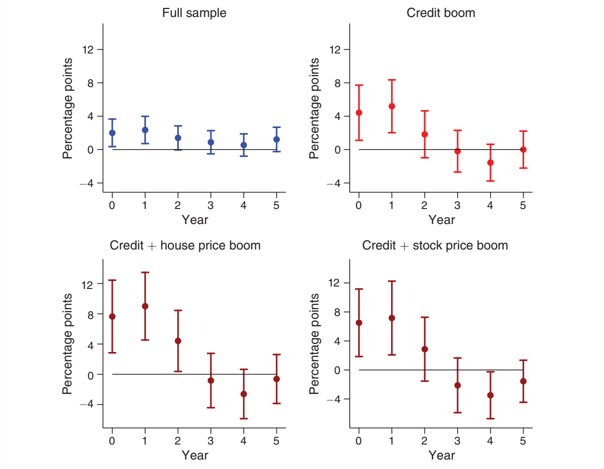


◂ Back to counterfactuals and IRFs

Schularick at al (2021)

▶ **Leaning against the wind and crisis risk**

Effect on annual crisis probability of an unexpected 1 pp policy rate hike



"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".* Back to main

Backstop policies increase welfare

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

- Mix of SIT and backstop ("Fed put") reduces the welfare loss to 0.0012% (from 0.1114%)
- The financial sector is more fragile when it is backstopped though, which forces the central bank to intervene 15% of the time

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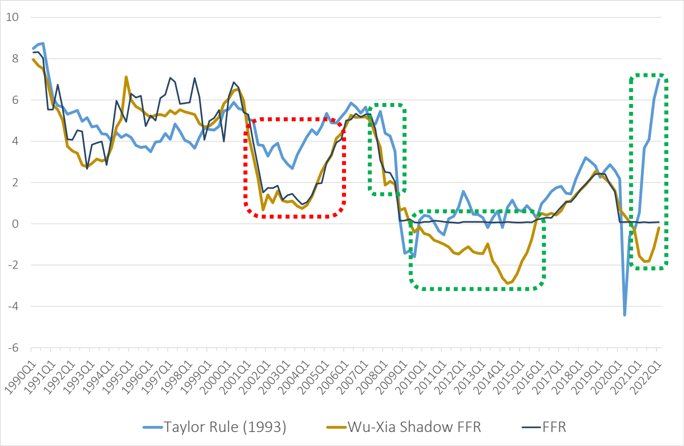
Deviation from Taylor (1993) rule and shadow policy rate

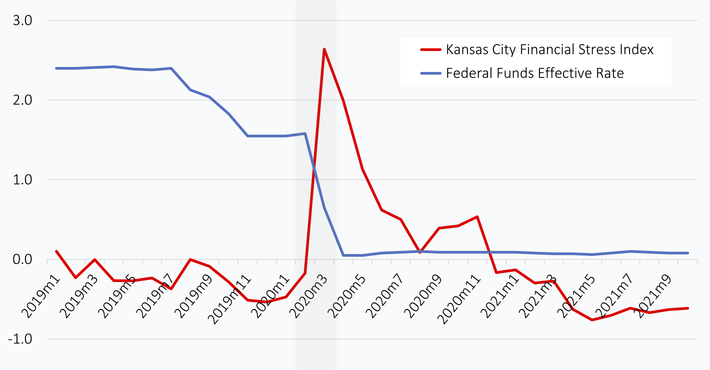


Source: Federal Reserve Bank of Atlanta

MP has likely prevented a financial crisis during the Covid-19 pandemic

Figure 1

Financial stability risk and monetary policy during Covid-19



Source: FRED