Inflation and Deflation Pressures after the COVID Shock

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– Preliminary –
Work in progress

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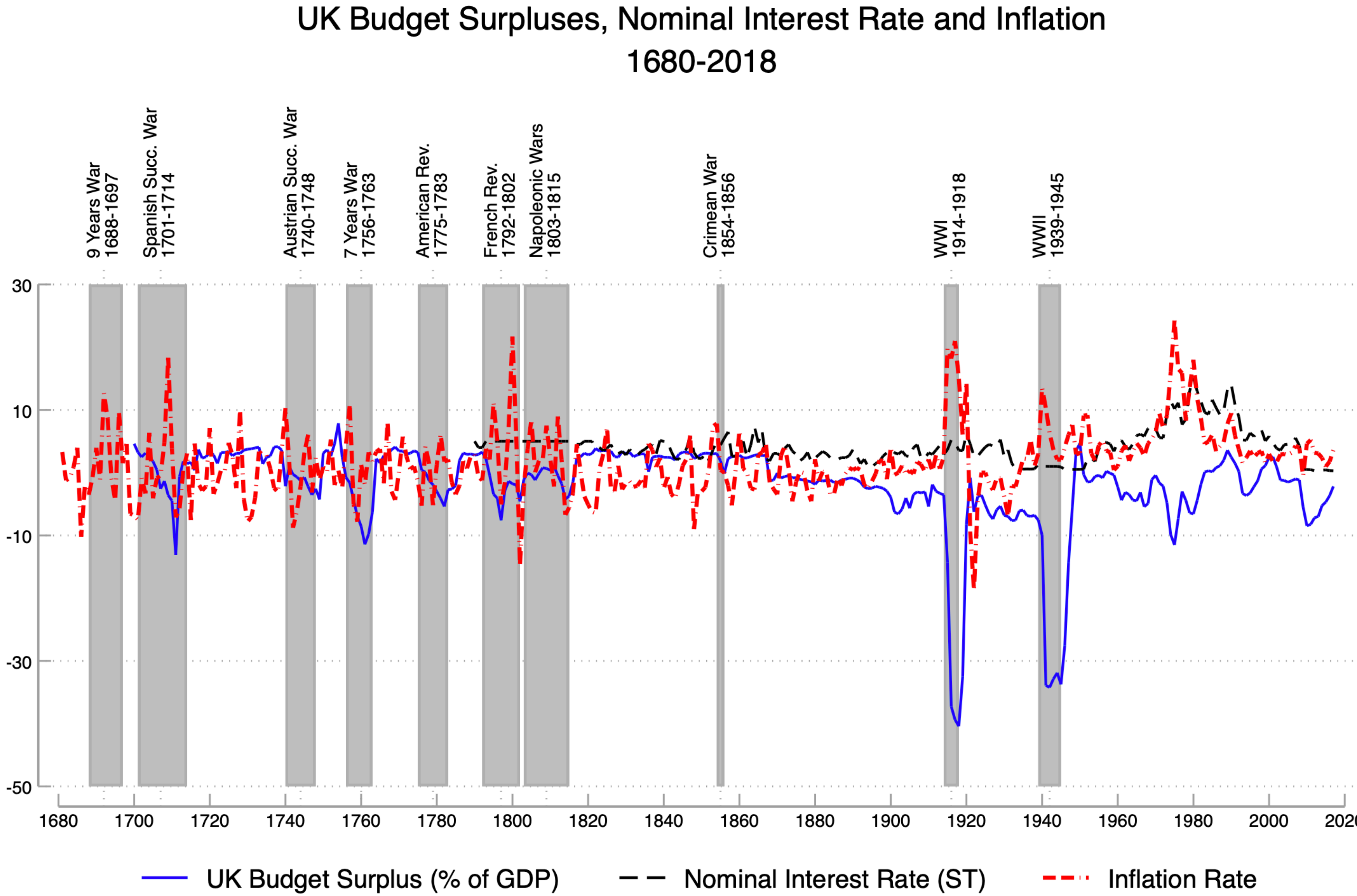
Key Takeaways

- Inflation and deflation pressures are multifold with subtle interactions
- Gov. debt serves as safe asset
  - precautionary savings instrument in world with incomplete markets
- Inflation (dynamics) is driven by
  - "Gamble on recovery" ... if pandemics lasts longer than expected
  - Financial frictions: incomplete markets & borrowing constraint
  - Inequality and redistribution
  - Government funding
    - Debt financing and future taxes (what taxes?)
    - Debt monetization

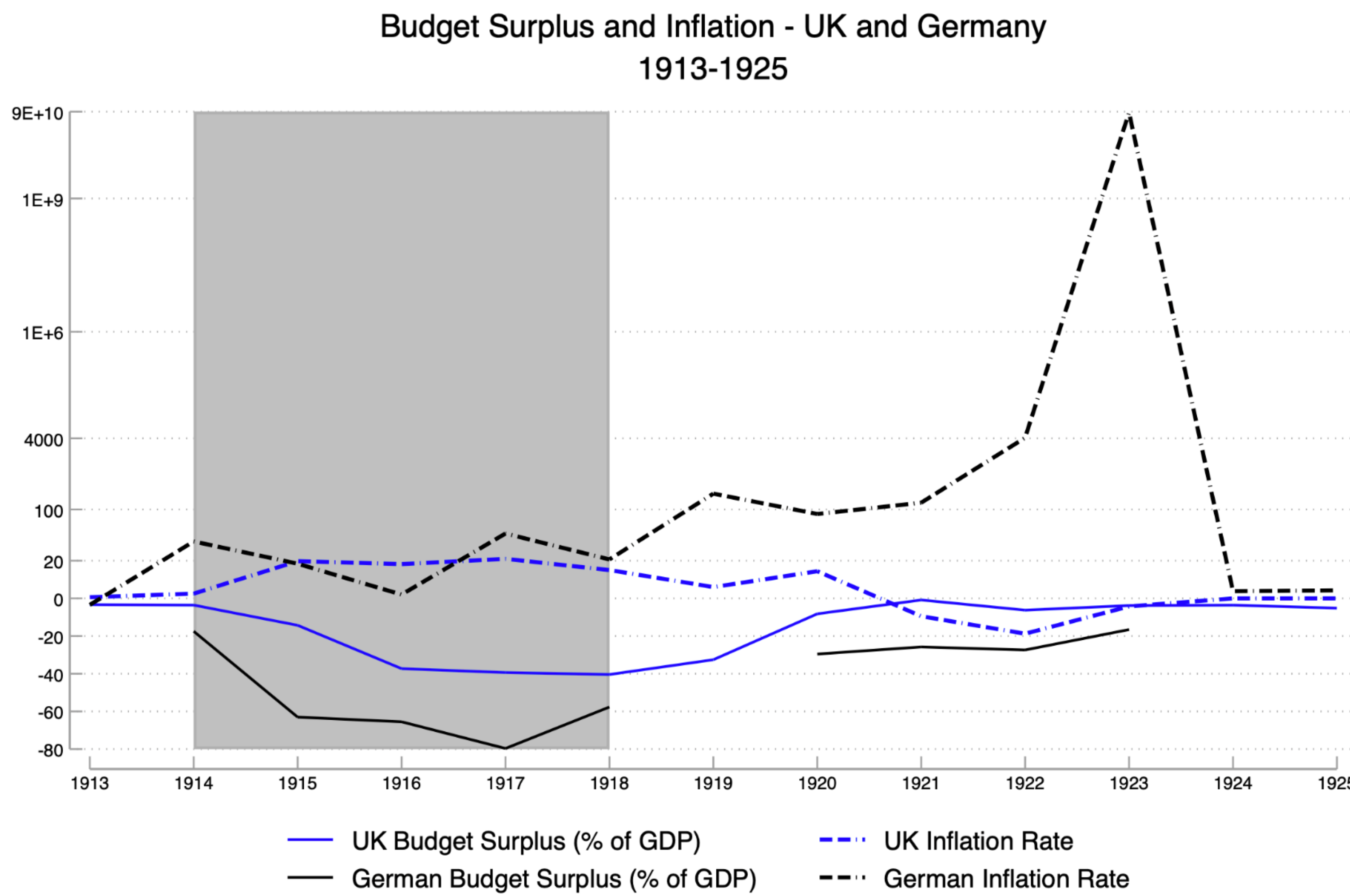
UK: inflation-fiscal link + wars



Source: ukpulicrevenues.co.uk, MeasuringWorth.com, Young (1925), Maddison (2010), Schmelzing (2020)

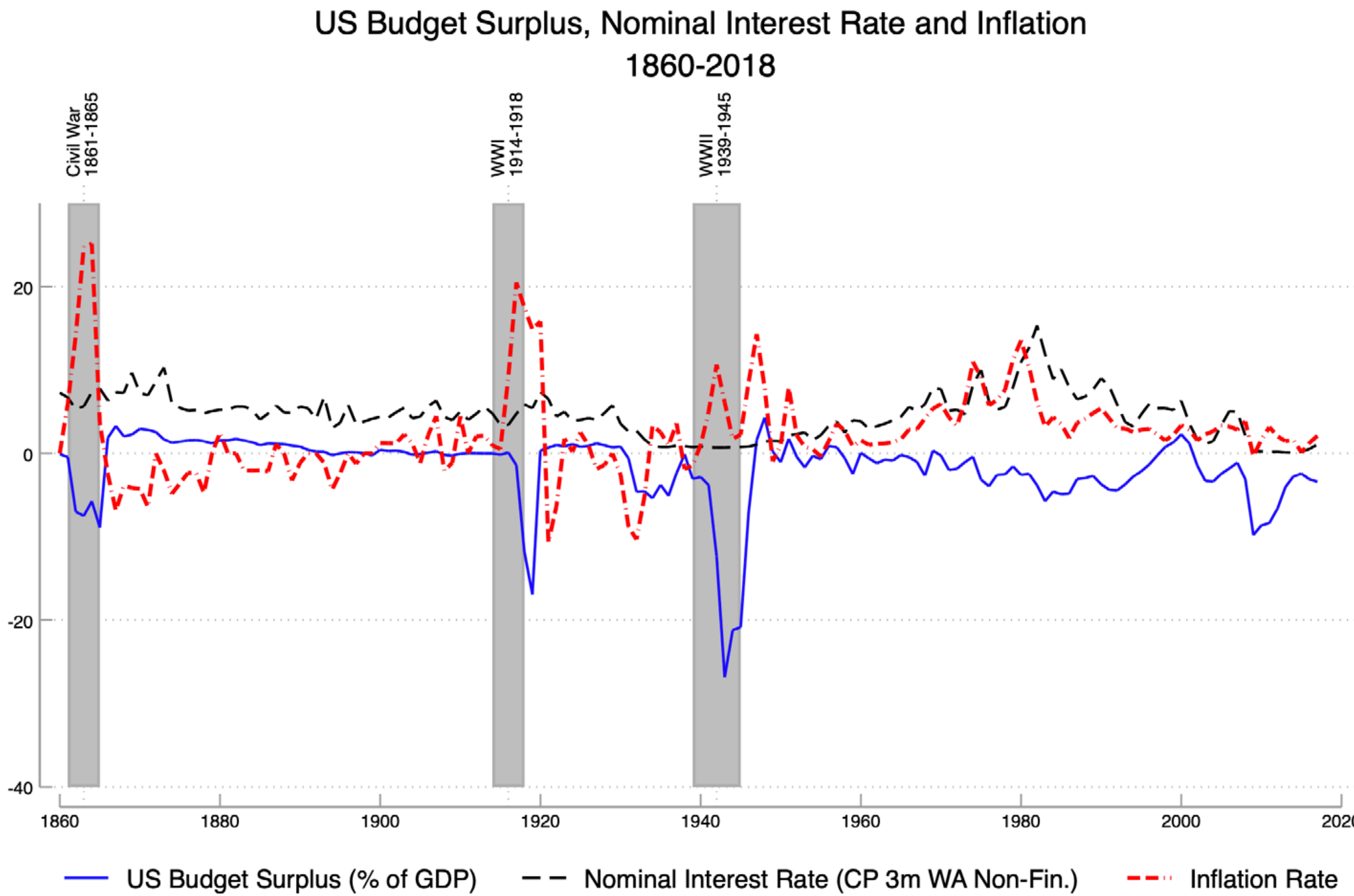
UK vs Germany after WWI

- War financing ≈≠ COVID (GDP and G)



- Balderston 1989, Dornbusch 1996, Harold James 2020: Princeton webinar

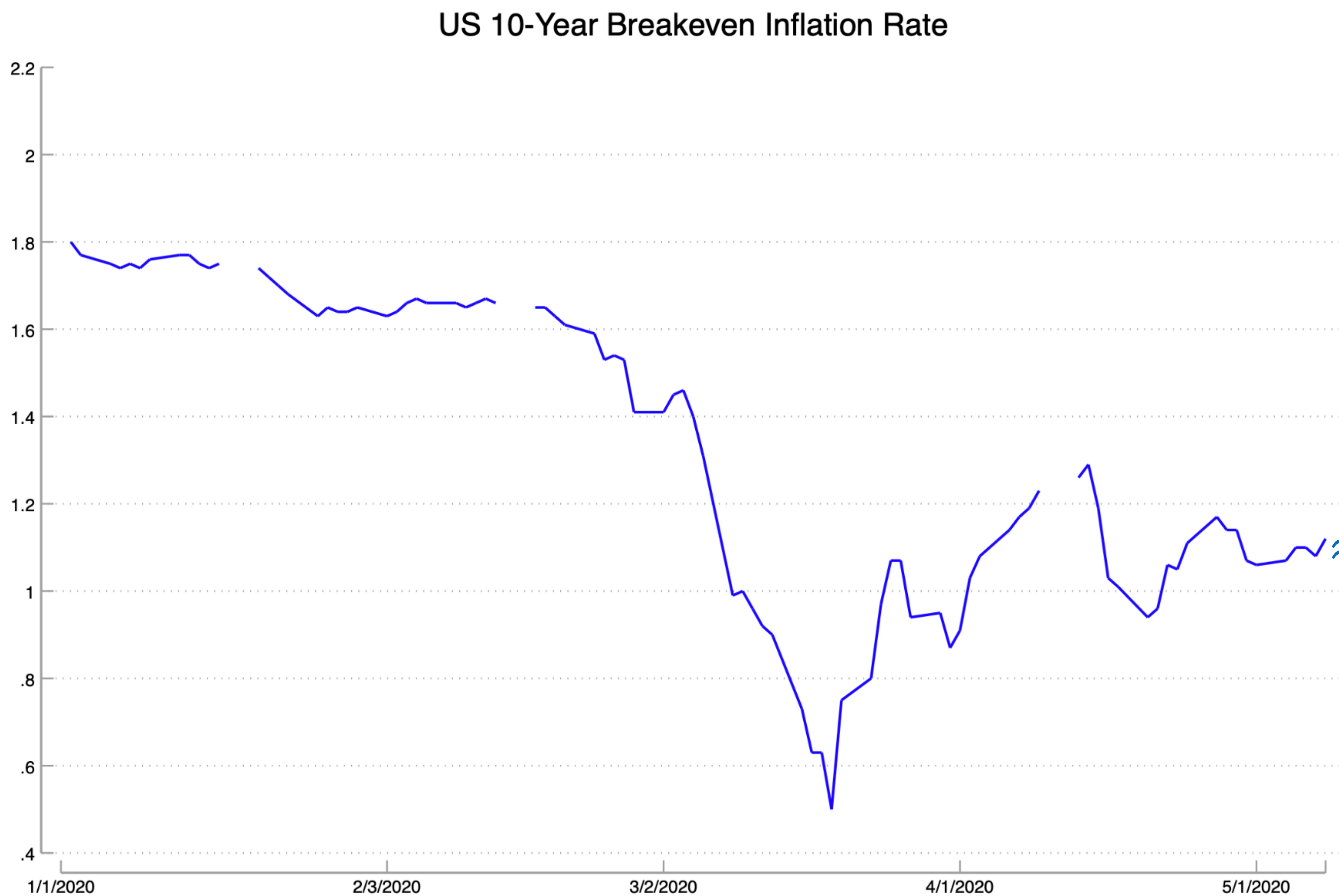
US: inflation-fiscal link + wars



Source: FRED, MeasuringWorth.com, Mitchell (1908)

US Inflation expectations now

- TIPS: 10 year break even



$\approx 1.1\%$

Brunnermeier, Merkel, Payne & Sannikov

Overview

- Historical examples

- Model setup
  - Uninsurable idiosyncratic risk on capital
    ⇒ risk premium on $r^K > g > r^f$ is depressed

- Solutions
  - Steps for all phases
  - Phase by phase

- Dissection inflation/deflation forces

- Policy measures and inflation

Literature: Money as Store of Value

\Friction	OLG	Incomplete Markets + idiosyncratic risk	
Risk	deterministic	labor endowment risk borrowing constraint	capital risk
Only money	Samuelson	Bewley	
			“I Theory without I”
With capital	Diamond	Aiyagari	Angeletos
	$f'(k^*) = r^*$, Dynamic inefficiency $r < r^*, K > K^*$	Inefficiency $r < r^*, K > K^*$	Pecuniary externality Inefficiency $r >? r^*, K <? K^*$

Money/gov. debt Ponzi scheme/bubbles if $r < g$

- Abel et al. vs. Geerolf (2013)
- Blanchard (2019)
- Jiang, Van Nieuwerburgh, Lustig, Xiaolan (2020)

Selected literature

- Sargent & Wallace “inflation is … a fiscal phenomenon”
- (Modern Monetary Theory)
- “Fiscal Theory of the Price Level with a Bubble”
  - Brunnermeier, Merkel & Sannikov (2020)

- BruSan (2018) “The I Theory of Money”

- New Keynesian models (demand management)
  - Woodford, Gali, HANK, … (cashless limit)
  - So far, we abstract from price stickiness

Broad money definition

- Broad MONEY definition – safe asset/store of value
  - Narrow Money
    Reserves = consol bond with floating nominal interest i_t
    - ignore small interest rate advantage of narrow money
      due to medium of exchange role of money (CIA, MIU, Shopping time, …)

  + Government debt (credibly default free, no second safe asset/currency)

Like in Samuelson's OLG model!

- Crisis dynamics of
  medium of exchange role of money < of store of value role

The challenge also for model setup

- Stop clock = total standstill of
  all debt/rent/wages/…

- Not possible
  - Essential sector food, …
  - Less essential sector

- Shut down part of economy
  - Supported by other part
    – via government financing (debt vs. monetization)?

Model setup

- Citizen $\tilde{\imath}$'s preferences

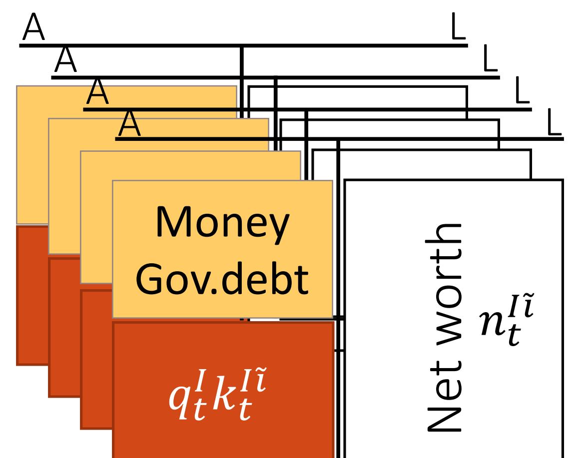
$$E\left[\int_0^\infty e^{-\rho t}\ln(c_t^{\tilde{\imath}})\,dt\right]$$

$$c_t^I = \left[\alpha_t^A (c_t^{A\tilde{\imath}})^{\frac{\varepsilon-1}{\varepsilon}} + \bar{\alpha}(c_t^{B\tilde{\imath}})^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}$$

	Sector A	Sector B
Output:	$y_t^{A\tilde{\imath}} = a_t^A k_t^{I\tilde{\imath}}$	$y_t^{Bi} = \bar{a} k_t^{B\tilde{\imath}}$
Physical capital:	$\frac{dk_t^{A\tilde{\imath}}}{k_t^{A\tilde{\imath}}} = (\Phi(\iota_t^A) - \delta)dt + \tilde{\sigma}_t d\tilde{Z}_t^{A\tilde{\imath}} + d\Delta_t^{k,A\tilde{\imath}}$	$\frac{dk_t^{B\tilde{\imath}}}{k_t^{B\tilde{\imath}}} = (\Phi(\iota_t^B) - \delta)dt + \tilde{\sigma}_t d\tilde{Z}_t^{B\tilde{\imath}} + d\Delta_t^{k,B\tilde{\imath}}$

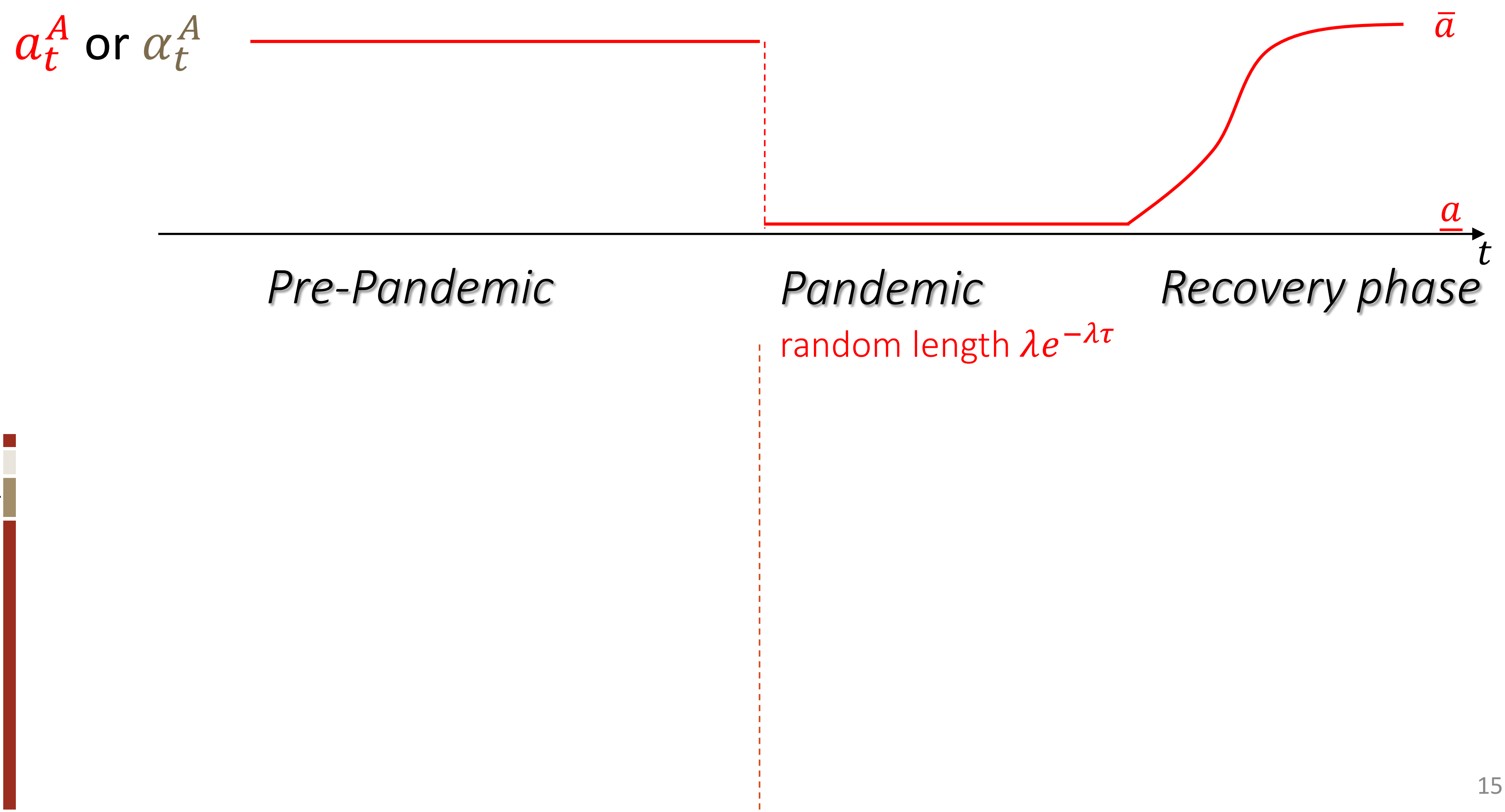
  - Investment is in CES-composite good

- Financial Frictions:
  - Agents cannot share $d\tilde{Z}_t^{I\tilde{\imath}}$
    - $\Rightarrow$ gives value to money/gov. debt
  - Borrowing constraint $\theta^{MI\tilde{\imath}} > -\underline{\theta}^M$



Shocks: Pandemic + Recovery

- CES: $c_t^I = \left[\alpha_t^A (c_t^{A\tilde{\imath}})^{\frac{\varepsilon-1}{\varepsilon}} + \bar{\alpha}(c_t^{B\tilde{\imath}})^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}$
- Output: $y_t^{Ai} = a_t^A k_t^{I\tilde{\imath}}, \quad y_t^{Bi} = \bar{a} k_t^{B\tilde{\imath}}$



Shocks: Pandemic + Recovery

- CES: $c_t^I = \left[\alpha_t^A \left(c_t^{A\tilde{\imath}}\right)^{\frac{\varepsilon-1}{\varepsilon}} + \bar{\alpha}\left(c_t^{B\tilde{\imath}}\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}$
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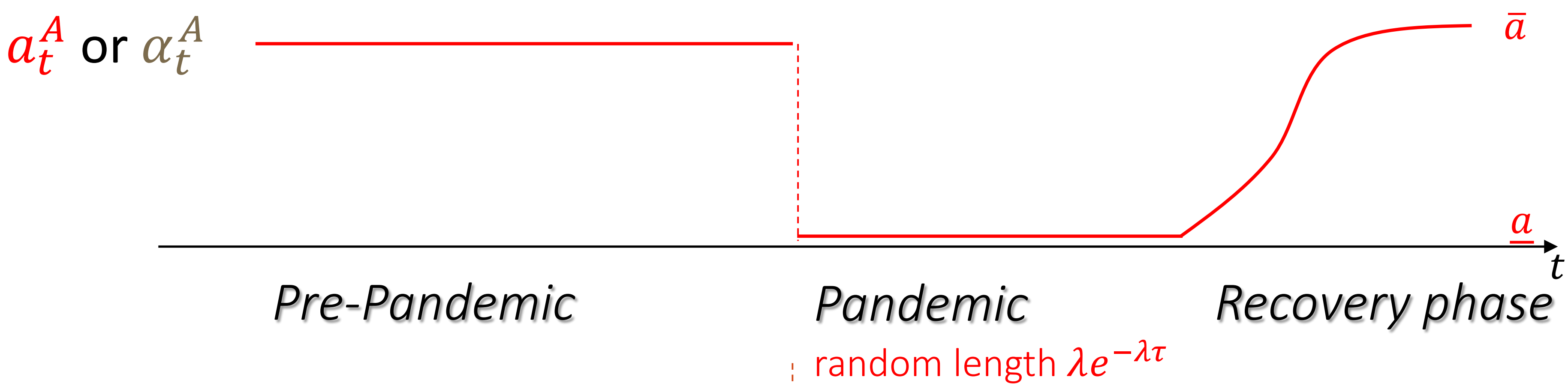

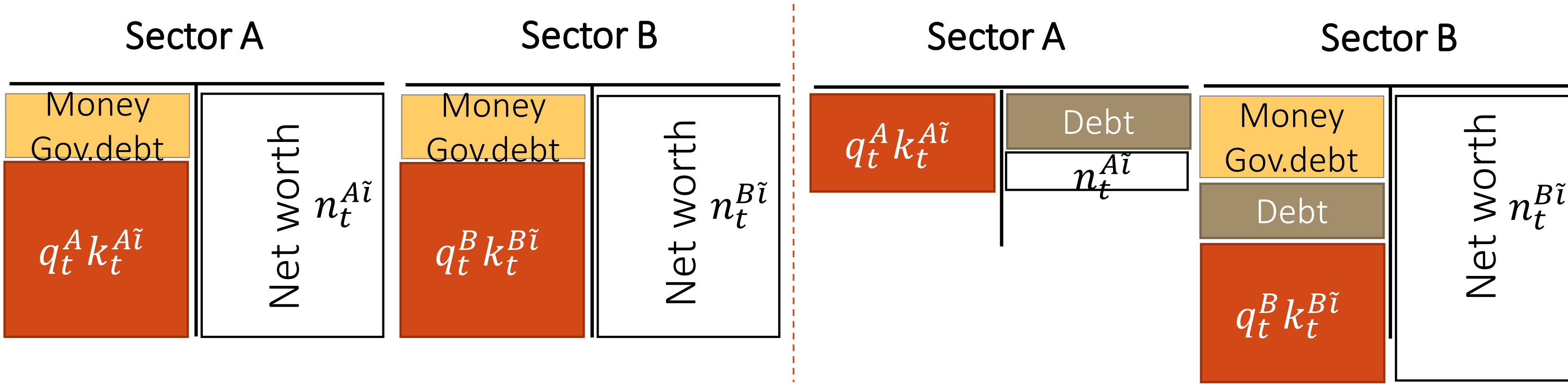

Gov. budget constraint

- Gov. budget constraints

$$(\mu_t^M - i_t)M_t/P_t + (\tau_t^A N_t^A + \tau_t^B N_t^B) = 0$$

  - Distribution of
    - seigniorage to all agents
    - Tax = - transfer

    } Proportional to net worth (wealth)

- Intertemporal gov. budget constraint contains bubble term
  - "FTPL with a Bubble"

Some notation

- Levels

$$K_t = K_t^A + K_t^B$$
$$N_t = N_t^A + N_t^B$$
$$q_t^K = \kappa_t q_t^A + (1-\kappa_t) q_t^B$$

- Shares

State variables

$$\kappa_t = K_t^A / K_t,$$
$$\eta_t = N_t^A / N_t$$
$$\varphi_t = \kappa_t q_t^A / q_t^K$$

Assumption: $\tilde{\sigma}_t = \tilde{\sigma}(\kappa_t)$ +

$$N_t = q_t^K K_t + q_t^M K_t \qquad \vartheta_t = \frac{q_t^M K_t}{(q_t^K + q_t^M) K_t}$$

Nominal wealth share (portfolio)

Solve model in shares

Translate back in levels

- Composite good (consider intermediary goods sector)

$$\mathcal{A}(\kappa_t; a_t^A, \alpha^A) K_t = \left[\alpha_t^A (a_t^A \kappa_t)^{\frac{\varepsilon-1}{\varepsilon}} + \bar{\alpha}(\bar{a}(1-\kappa_t))^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}} K_t$$

- Money supply $\frac{dM_t}{M_t} = \mu_t^M dt + \nu_t^M dJ_t$

"Inflation tax" $\mu_t^M - i_t$

Jumps: COVID + recovery

Overview

- Historical examples
- Model setup
- Solutions for all phases
- Phase by phase
- Policy and inflation

Optimal choices

- Optimal investment rate ι_t^I (in composite good) in Sector I

$$\iota_t^I = \frac{1}{\phi}(q_t^I - 1)$$

$$\frac{1}{q_t^I} = \Phi'(\iota_t^{I\tilde{\imath}})$$ Tobin's q

All agents $\iota_t^{I\tilde{\imath}} = \iota_t^I$

Special functional form:

$$\Phi(\iota_t^I) = \frac{1}{\phi}\log(\phi\iota_t^I + 1)$$

Evolution of capital share κ

$$\mu_t^\kappa = (1-\kappa_t)\left(\Phi(\iota_t^A) - \Phi(\iota_t^B)\right) = (1-\kappa_t)\log(q_t^A/q_t^B)$$

Optimal choices

- Optimal investment rate ι_t^I

$$\iota_t^I = \frac{1}{\phi}(q_t^I - 1)$$

- Optimal consumption

$$c_t^{I\tilde{\imath}} = \rho n_t^{I\tilde{\imath}}$$

- Optimal portfolio ($\theta_t^{M,I}, \theta_t^{K,I}$)

$$\theta_t^{M,A} = \cdots$$

$$\theta_t^{M,B} = \cdots$$

Optimal choices & aggregation

- Optimal investment rate ι_t^I

$\iota_t^I = \frac{1}{\phi}(q_t^I - 1)$

- Optimal consumption

$c_t^{I\tilde{\imath}} = \rho n_t^{I\tilde{\imath}} \Rightarrow C_t = \rho(N_t^A + N_t^B)$

$$\rho[\underbrace{(q_t^A \kappa_t + q_t^B(1-\kappa_t))}_{=q_t^K} + \underbrace{q_t^M}_{\text{Value of Money/gov. debt}}]K_t$$

- Optimal portfolio $(\theta_t^{M,I}, \theta_t^{K,I})$

$\theta_t^{M,A} = \cdots$

$\theta_t^{M,B} = \cdots$

Let's solve optimal portfolio later.

Optimal choices & aggregation

- Optimal investment rate ι_t^I

$$\iota_t^I = \frac{1}{\phi}(q_t^I - 1)$$

- Optimal consumption

$$c_t^{I\tilde{\imath}} = \rho n_t^{I\tilde{\imath}} \Rightarrow C_t = \rho(N_t^A + N_t^B)$$

$$\rho[\underbrace{(q_t^A \kappa_t + q_t^B(1-\kappa_t))}_{=q_t^K} + q_t^M]K_t$$

- Optimal portfolio $(\theta_t^{M,I}, \theta_t^{K,I})$

$$\theta_t^{M,A} = \cdots \qquad \underbrace{[\theta_t^{M,A}\eta_t + \theta_t^{M,B}(1-\eta_t)]}_{\vartheta_t :=} N_t$$

$$\theta_t^{M,B} = \cdots$$

Let's solve optimal portfolio later.

Optimal choices & market clearing

- Optimal investment rate ι_t^I

$$\iota_t^I = \frac{1}{\phi}(q_t^I - 1)$$

- Optimal consumption

$$c_t^{I\tilde{\imath}} = \rho n_t^{I\tilde{\imath}} \Rightarrow C_t = \rho(N_t^A + N_t^B)$$

$$\rho[\underbrace{(q_t^A \kappa_t + q_t^B(1-\kappa_t))}_{=q_t^K} + q_t^M]K_t \quad = (\mathcal{A}_t - \iota_t)K_t$$

- Optimal portfolio $(\theta_t^{M,I}, \theta_t^{K,I})$

$$\theta_t^{M,A} = \cdots \qquad \underbrace{[\theta_t^{M,A}\eta_t + \theta_t^{M,B}(1-\eta_t)]}_{\vartheta_t :=} N_t = q_t^M K_t$$

$$\theta_t^{M,B} = \cdots$$

Let's solve optimal portfolio later.

Optimal ι + goods market

- Price of physical composite capital

$$q_t^K = (1-\vartheta_t)\frac{1+\phi\mathcal{A}(\kappa_t; a_t^A)}{(1-\vartheta_t)+\phi\rho}$$

- Real value of money per unit of K_t

$$q_t^M = \vartheta_t \underbrace{\frac{1+\phi\mathcal{A}(\kappa_t; a_t^A)}{(1-\vartheta_t)+\phi\rho}}_{=q_t^K+q_t^M=N_t/K_t}$$

- Moneyless equilibrium: $q_t^M = 0 \Rightarrow \vartheta_t = 0 \Rightarrow q_t^K = \frac{1+\phi\mathcal{A}(\kappa_t;a_t^A)}{1+\phi\rho}$
  - Real value of government debt is fragile!

Drifts

- $\mu_t^K = \kappa_t \Phi(\iota_t^A) + (1-\kappa_t)\Phi(\iota_t^B) - \delta$

forward equations

- $\mu_t^\kappa = (1-\kappa_t)\left(\Phi(\iota_t^A) - \Phi(\iota_t^B)\right) = (1-\kappa_t)\log(q_t^A/q_t^B)$
- $\mu_t^\eta = (1-\eta_t)((\text{risk premium})\theta_t^{K,A} - (\text{risk premium})\theta_t^{K,B})$
- $\mu_t^\varphi = (1-\varphi_t)(\mu_t^{q^A} - \mu_t^{q^A} + \frac{\mu_t^\kappa}{1-\kappa_t})$

backward equations

Money demand

- $\mu_t^\vartheta = \rho - \underbrace{(1-\vartheta_t)^2 \tilde{\sigma}_t^2 \left(\frac{\varphi^2}{\eta_t} + \frac{(1-\varphi)^2}{1-\eta_t}\right)}_{\text{weighted idio-risk premium}} + \underbrace{(1-\vartheta_t)(\mu_t^M - i_t)}_{\text{seignorage distribution to } K}$

$+\lambda(1-\vartheta_t)(\text{weighted jump-risk premium})$

$-(1-\vartheta_t)\underbrace{(\psi_t^A - \psi_t^B)}_{\text{Lagrange multipl. borrowing constr.}}$

Drifts

- $\mu_t^K = \kappa_t \Phi(\iota_t^A) + (1-\kappa_t)\Phi(\iota_t^B) - \delta$
- $\mu_t^\kappa = (1-\kappa_t)\left(\Phi(\iota_t^A) - \Phi(\iota_t^B)\right) = (1-\kappa_t)\log(q_t^A/q_t^B)$
- $\mu_t^\eta = (1-\eta_t)((\text{risk premium})\theta_t^{K,A} - (\text{risk premium})\theta_t^{K,B}$
- $\mu_t^\varphi = (1-\varphi_t)(\mu_t^{q^A} - \mu_t^{q^A} + \frac{\mu_t^\kappa}{1-\kappa_t})$

Money demand

- $\mu_t^\vartheta = \rho - \underbrace{(1-\vartheta_t)^2 \tilde{\sigma}_t^2 \left(\frac{\varphi^2}{\eta_t} + \frac{(1-\varphi)^2}{1-\eta_t}\right)}_{\text{weighted idio-risk premium}} + \underbrace{(1-\vartheta_t)(\mu_t^M - i_t)}_{\text{"inflation tax" } \check{\mu}_t^M :=}$
  $+\lambda(1-\vartheta_t)(\text{weighted jump-risk premium})$
  $-(1-\vartheta_t) \underbrace{(\psi_t^A - \psi_t^B)}_{\text{Lagrange multipl. borrowing constr.}}$

Drifts

- $\mu_t^K = \kappa_t \Phi(\iota_t^A) + (1-\kappa_t)\Phi(\iota_t^B) - \delta$
- $\mu_t^\kappa = (1-\kappa_t)\left(\Phi(\iota_t^A) - \Phi(\iota_t^B)\right) = (1-\kappa_t)\log(q_t^A/q_t^B)$
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Money demand

- $\mu_t^\vartheta = \rho - \overbrace{(1-\vartheta_t)^2 \tilde{\sigma}_t^2 \left(\frac{\varphi^2}{\eta_t} + \frac{(1-\varphi)^2}{1-\eta_t}\right)}^{\text{weighted idio-risk premium}} + \overbrace{(1-\vartheta_t)(\mu_t^M - i_t)}^{\text{"inflation tax"}\ \breve{\mu}_t^M :=}$

$$\vartheta_t = E_t \int_t^\infty e^{-\rho(s-t)}[(1-\vartheta_s)(i - \mu_s^M) + (1-\vartheta_s)^2 \left(\frac{\varphi_s^2}{\eta_s} + \frac{(1-\varphi_s)^2}{1-\eta_s}\right)\tilde{\sigma}_s^2]\vartheta_s ds$$

Portfolio distortion due to inflation tax

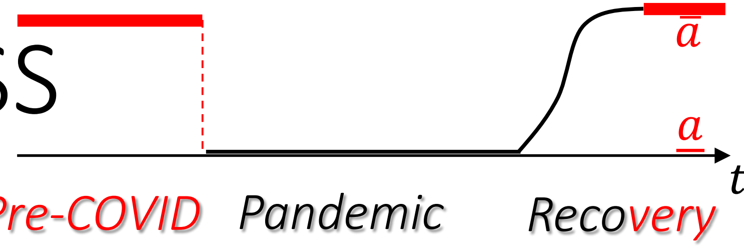
"payoff" Insurance service flow

Overview

- Historical examples
- Model setup
- Solutions for all phases
- Phase by phase
  - I. Pre-pandemic
  - II. Pandemic
  - III. Recovery

- Policy and inflation

I. Phase: Non-pandemic SS



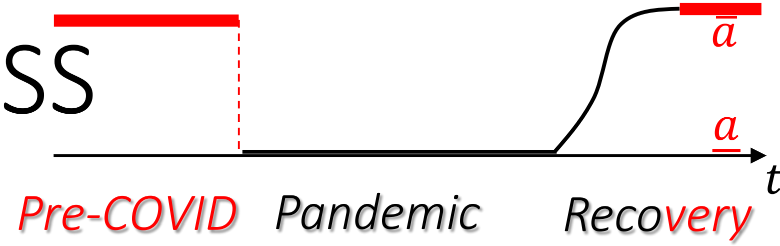
(start and endpoint)

- In SS & deterministic
  since pandemics is a zero probability shock

- $0 = \mu_t^{\kappa} = (1-\kappa_t)\log(q_t^A/q_t^B) \Rightarrow q_t^A = q_t^B \Rightarrow \varphi^{SS} = \kappa^{SS} = \frac{1}{2}$
- $0 = \mu_t^{\eta} = (1-\vartheta)^2 \tilde{\sigma}_t^2 \left(\frac{\varphi^2}{\eta_t} + \frac{(1-\varphi)^2}{1-\eta_t}\right)(1-\eta_t)\eta_t \quad \Rightarrow \varphi^{SS} = \eta^{SS} = \frac{1}{2}$
- $0 = \mu_t^{\varphi} = (1-\varphi_t)(\mu_t^{q^A} - \mu_t^{q^A} + \frac{\mu_t^{\kappa}}{1-\kappa_t}) \Rightarrow p_t^{A,SS} = p_t^{B,SS}$
- $0 = \mu_t^{\vartheta} = \rho - (1-\vartheta)^2 \tilde{\sigma}_t^2 \left(\frac{\varphi^2}{\eta} + \frac{(1-\varphi)^2}{1-\eta}\right) + \underbrace{(1-\vartheta)(\mu^M - i)}_{\breve{\mu}^M :=}$

$$\Rightarrow 1 - \vartheta^{SS} = \frac{\sqrt{\rho + \breve{\mu}^M}}{\tilde{\sigma}(\kappa^{SS})}$$

I. Phase: Non-pandemic SS



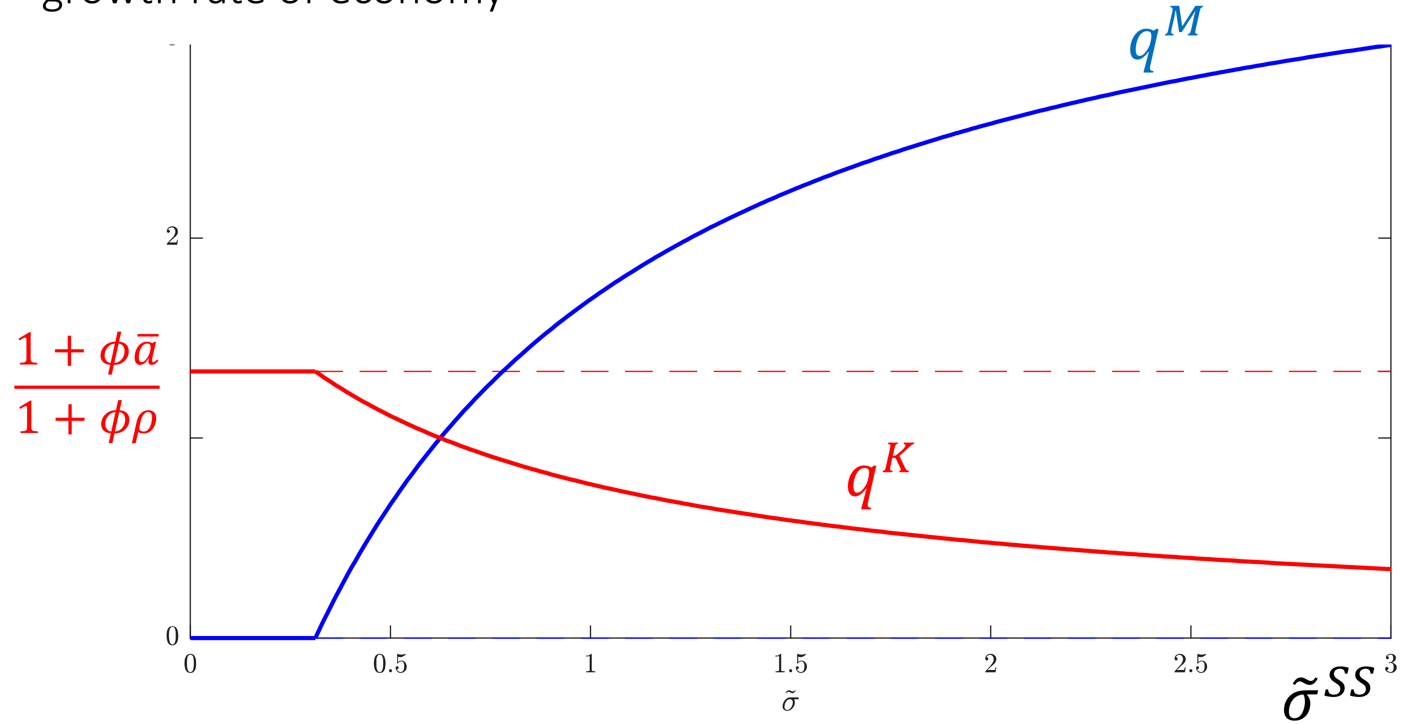
Moneyless equilibrium	Money equilibrium
$q_0^M = 0$	$q^M = \dfrac{\left(\tilde{\sigma} - \sqrt{\rho + \check{\mu}^M}\right)(1 + \phi\bar{a})}{\sqrt{\rho + \check{\mu}^M} + \phi\tilde{\sigma}\rho}$
$q_0^K = \dfrac{1 + \phi\bar{a}}{1 + \phi\rho}$	$q^K = \dfrac{\sqrt{\rho + \check{\mu}^M}\ (1 + \phi\bar{a})}{\sqrt{\rho + \check{\mu}^M} + \phi\tilde{\sigma}\rho}$
$\iota^A = \iota^B = \dfrac{\bar{a} - \rho}{1 + \phi\rho}$	$\iota^A = \iota^B = \dfrac{\bar{a}\sqrt{\check{\mu}^M} - \tilde{\sigma}\rho}{\sqrt{\check{\mu}^M} + \phi\tilde{\sigma}\rho}$

For $\mu^M = i \quad \Rightarrow \check{\mu}^M = 0$
(no seigniorage since all money growth
is paid to money holders in form of interest)

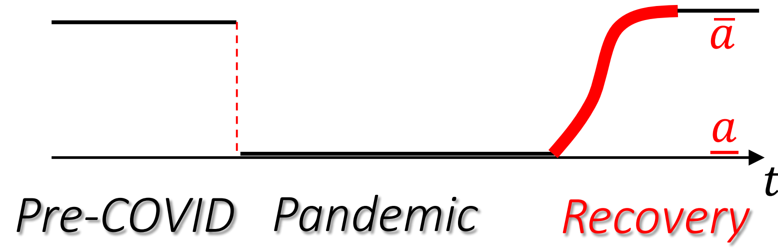
- Money is a bubble
  - But provides store of value/insurance role

I. Comparative static $\tilde{\sigma}^{SS}$

- Comparative static: As $\tilde{\sigma}$ increases
  - Flight to safety to bubbly money
    - q^M rises (disinflation)
    - q^K falls and so does
      - ι and
      - growth rate of economy



III. Recovery phase



- Pandemic random length, exponentially distributed $\lambda e^{-\lambda\tau}$

1. Jump at recovery news (vaccine discovery)
   - q^A and N jump up, and so is N^A and η
     - $C^A = \rho N^A$ jumps

2. Deterministic convergence to SS (only idiosyncratic risk)
   - a_t^A converges back to $\bar{a}$ (exogenously)
   - φ_t converges back to SS: $\varphi^{SS} = 1/2$
   - κ_t converges back to SS: $\kappa^{SS} = 1/2$ $\Rightarrow \tilde{\sigma}(\kappa_t)$ starts declining
     - $\vartheta_t = E_t \int_t^\infty e^{-\rho(s-t)}[(1-\vartheta_s)(i-\mu_s^M) + (1-\vartheta_s)^2 \left(\frac{\varphi_s^2}{\eta_s} + \frac{(1-\varphi_s)^2}{1-\eta_s}\right) \tilde{\sigma}_s^2]\vartheta_s ds$
   - K_t grows faster (but never fully makes up)
   - $\mathcal{A}(\kappa_t; a_t^A, \alpha^A)$ converges back to $\bar{a}$

II. Pandemic phase

- **For $t > 0$:** Aggregate recovery arrival jump risk
  - Sector A "gambles on recovery"
    - Holds on capital
    - Consumes and net worth share η_t declines as pandemic drags on
      - κ_t declines $\Rightarrow$ $\tilde{\sigma}_t$ rises
    - At some point borrowing constraint starts binding

$$\mu_t^{\vartheta} = \rho - \overbrace{(1-\vartheta_t)^2 \tilde{\sigma}_t^2 \left(\frac{\varphi^2}{\eta_t} + \frac{(1-\varphi)^2}{1-\eta_t}\right)}^{weighted\ idio-risk\ premium} + \overbrace{(1-\vartheta_t)(\mu_t^M - i_t)}^{seignorage\ distribution}$$

$$+\lambda(1-\vartheta_t)(\text{weighted jump-risk premium})$$

$$-(1-\vartheta_t) \underbrace{(\psi_t^A - \psi_t^B)}_{Lagrange\ multipl.\ borrowing\ constr.}$$

when borrowing constraint binds

Sector A accepts low return hoping for recovery with q^A jump up

- **At $t = 0$:** COVID shock (zero probability)

Brunnermeier, Merkel, Payne & Sannikov

II. Pandemic phase

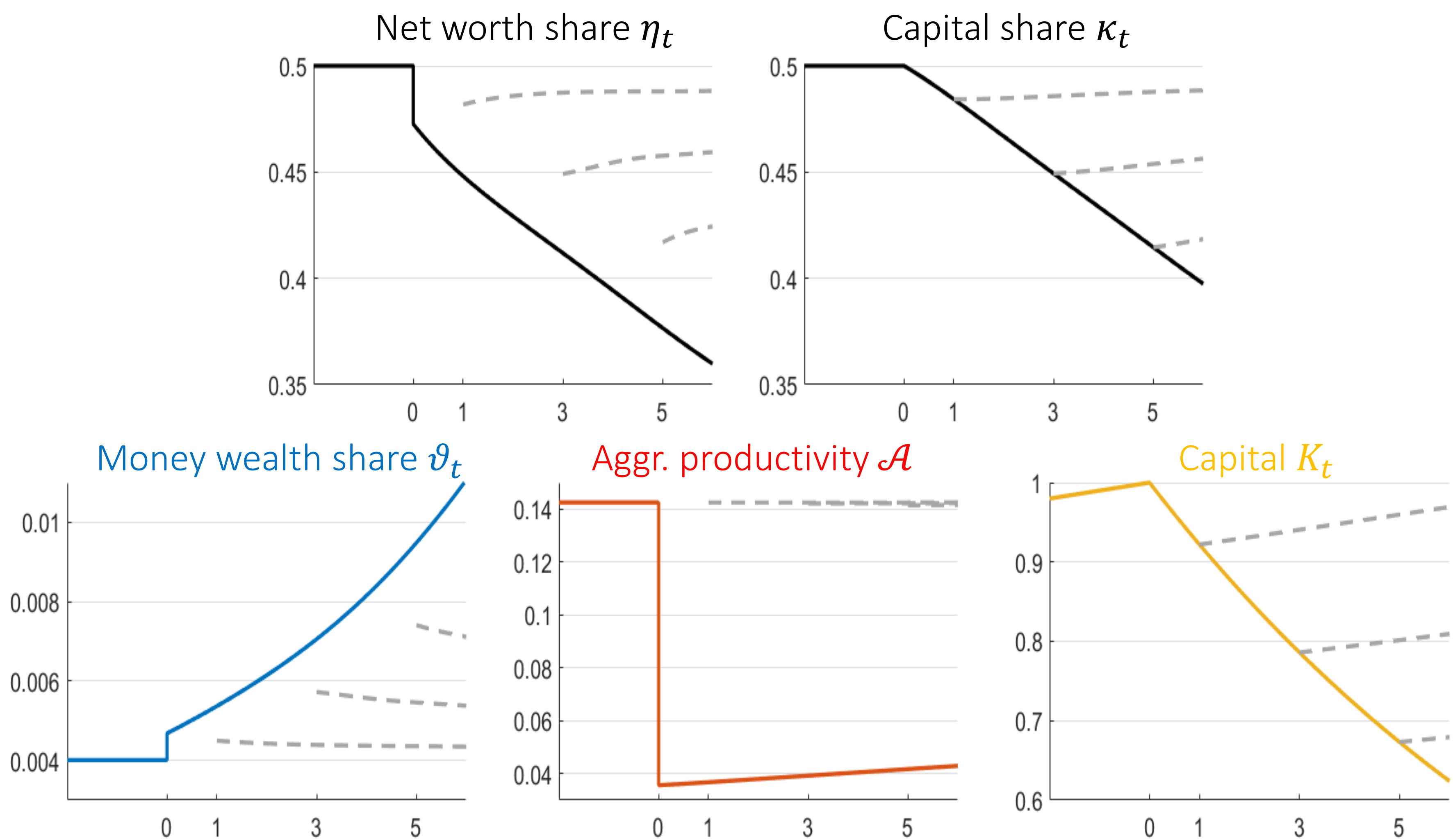
- **For $t > 0$:** Aggregate recovery arrival jump risk
  - Sector A "gambles on recovery"
    - Holds on capital
    - Consumes and net worth share η_t declines as pandemic drags on
      - κ_t declines $\Rightarrow$ $\tilde{\sigma}_t$ rises
    - At some point borrowing constraint starts binding
      - Affects already equilibrium before it binds

- **At $t = 0$:** COVID shock (zero probability)
  - $q^A_{0^+}$ drops more than $q^B_{0^+}$ $\Rightarrow \eta_{0^+}$ jumps
  - Price level P_{0^+} jumps due to 2 forces
    - \- Downwards: since $\mathcal{A}(\kappa_t; a^A_t)$ drops as a^A_t drops from $\bar{a}$ to $\underline{a}$
    - \+ Upwards: as PV("insurance service flow" of money) rises

$$\vartheta_t = E_t \int_t^{\infty} e^{-\rho(s-t)}\left[(1-\vartheta_s)(i-\mu^M_s) + (1-\vartheta_s)^2 \left(\frac{\varphi_s^2}{\eta_s} + \frac{(1-\varphi_s)^2}{1-\eta_s}\right)\tilde{\sigma}_s^2\right]\vartheta_s ds$$

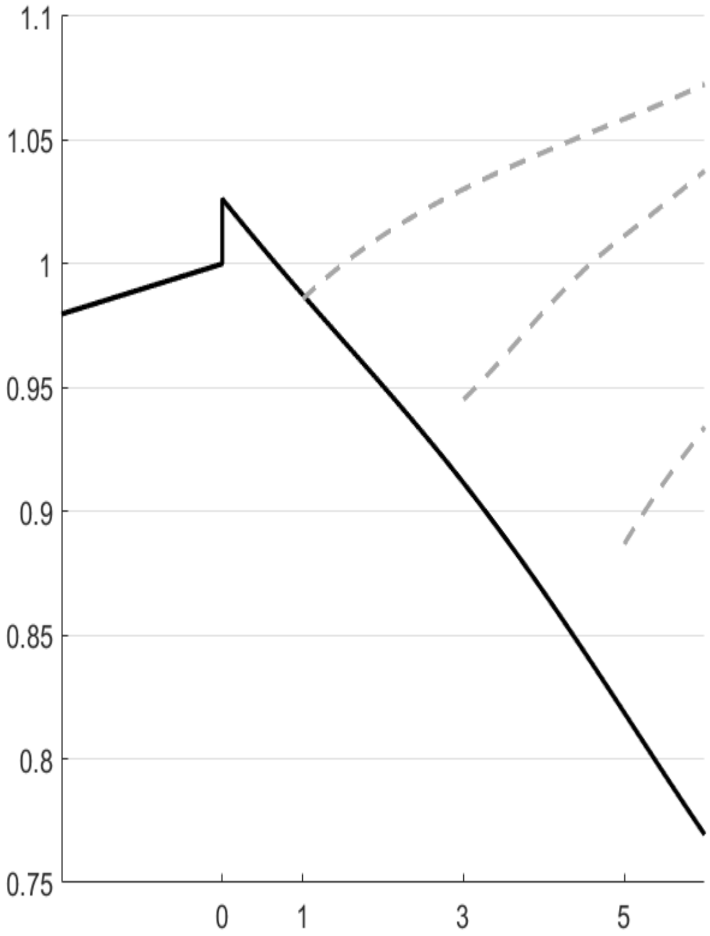
Time path after COVID shock/recovery shock

- $\rho = 1.5\%, \bar{a} = .22, \underline{a} = 0, \phi = 2, \delta = .1, \varepsilon = 2, \lambda = 1, \tilde{\sigma}(\kappa) = .125 + |\kappa - 1/2|$

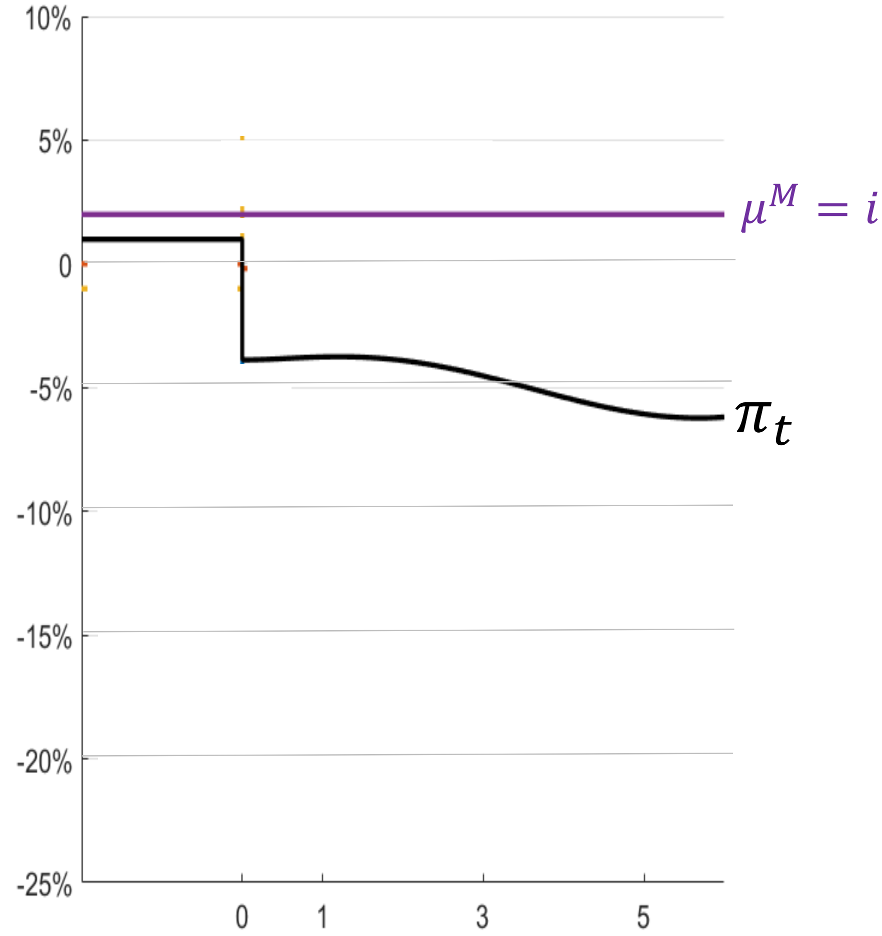


Price Level and Inflation

Price Level P_t



Inflation π_t



Dissecting inflation pressures

- Value of a coin: $\frac{q_t^M K_t}{M_t}$ Price level: $P_t = \frac{M_t}{q_t^M K_t}$
- $\pi_t = \mu_t^M - \mu_t^K - \mu_t^{q^M}$
  - $\mu_t^K = \kappa_t \Phi(\iota_t^A) + (1-\kappa_t)\Phi(\iota_t^B) - \delta$ capital factor growth rate
  - $\mu_t^{q^M} = \frac{\phi \mathcal{A}(\kappa_t; a_t^A)}{(1-\vartheta_t)+\phi\rho} \mu_t^{\mathcal{A}}(\kappa_t; a_t^A) + \frac{1+\phi\rho}{(1-\vartheta_t)+\phi\rho} \mu_t^{\vartheta}$ (from $q_t^M = \vartheta_t \frac{1+\phi\mathcal{A}(\kappa_t; a_t^A)}{(1-\vartheta_t)+\phi\rho}$)
- $\pi_t = +\mu_t^M$ money printing

  $-(\kappa_t \Phi(\iota_t^A) + (1-\kappa_t)\Phi(\iota_t^B) - \delta)$ capital factor growth

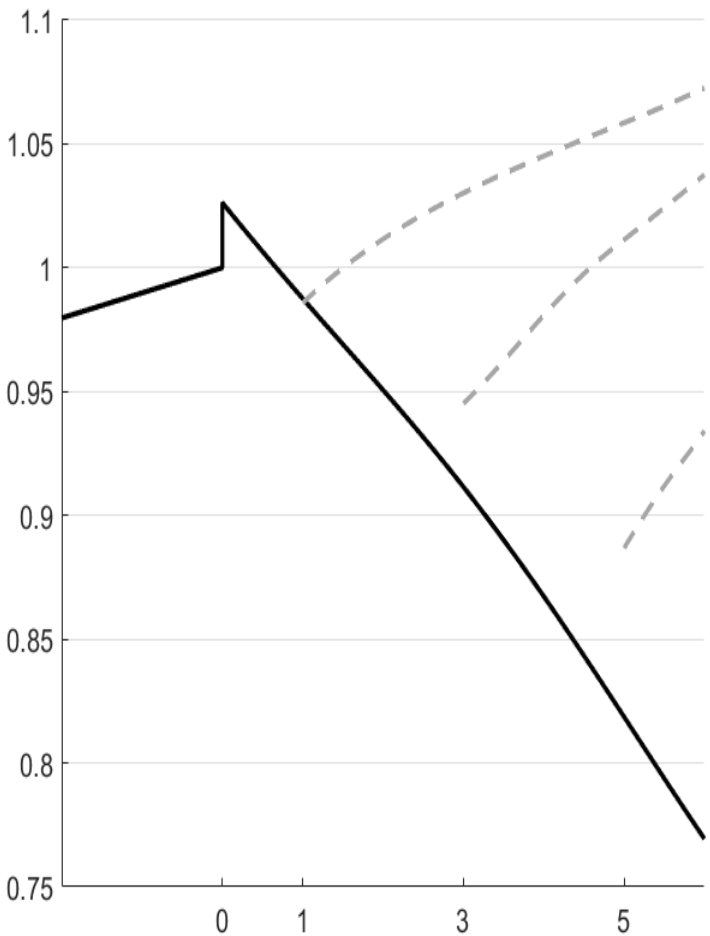
  $-\frac{\phi \mathcal{A}(\kappa_t; a_t^A)}{(1-\vartheta_t)+\phi\rho} \mu_t^{\mathcal{A}}(\kappa_t; a_t^A)$ productivity growth

  $-\frac{1+\phi\rho}{(1-\vartheta_t)+\phi\rho} \mu_t^{\vartheta}$ future idio-risk

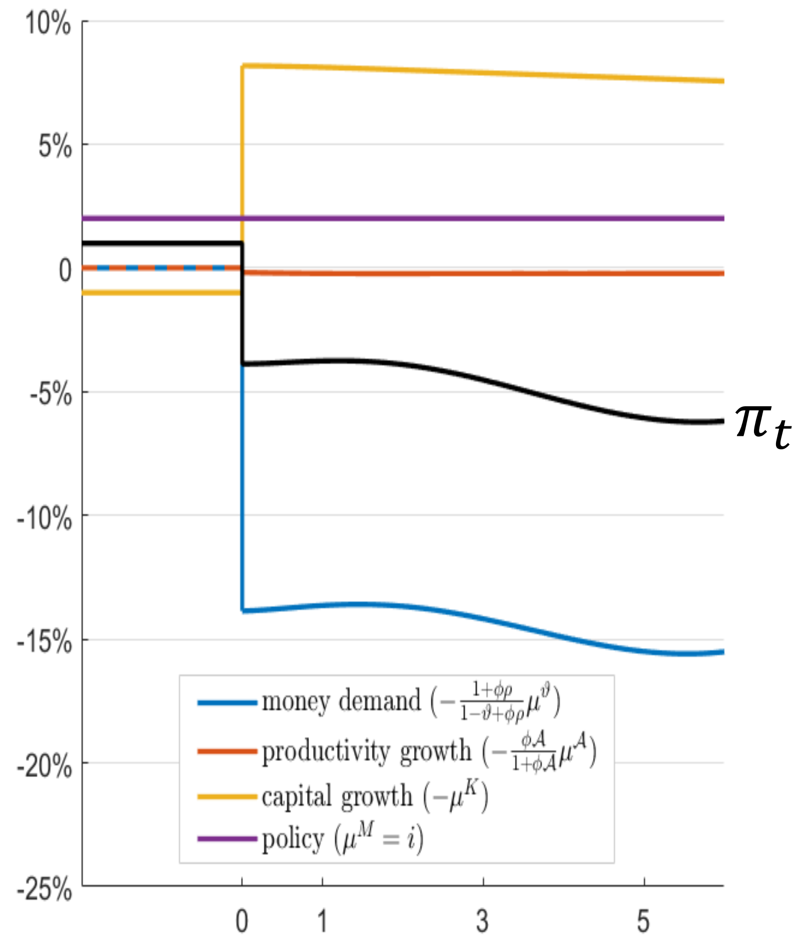
Brunnermeier, Merkel, Payne & Sannikov

Dissecting inflation pressures

Price Level P_t



Inflation π_t (components)



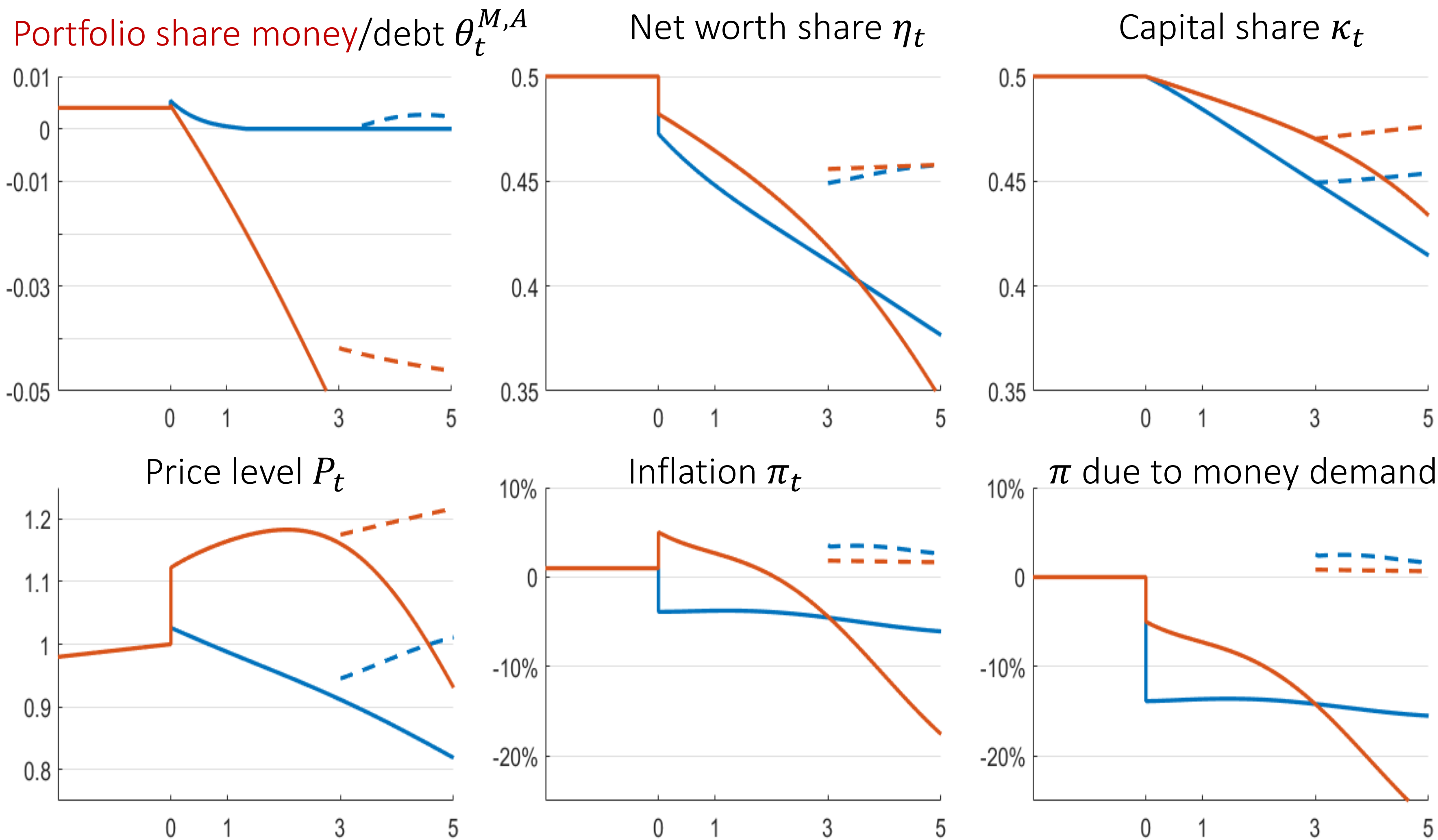
Overview

- Historical examples
- Model setup
- Solutions for all phases
- Phase by phase
- Policy and inflation
  - Lending policy
  - Intratemporal redistribution
  - Intertemporal
    - Fiscal debt financing to redistribute
    - Monetization

Lending policy

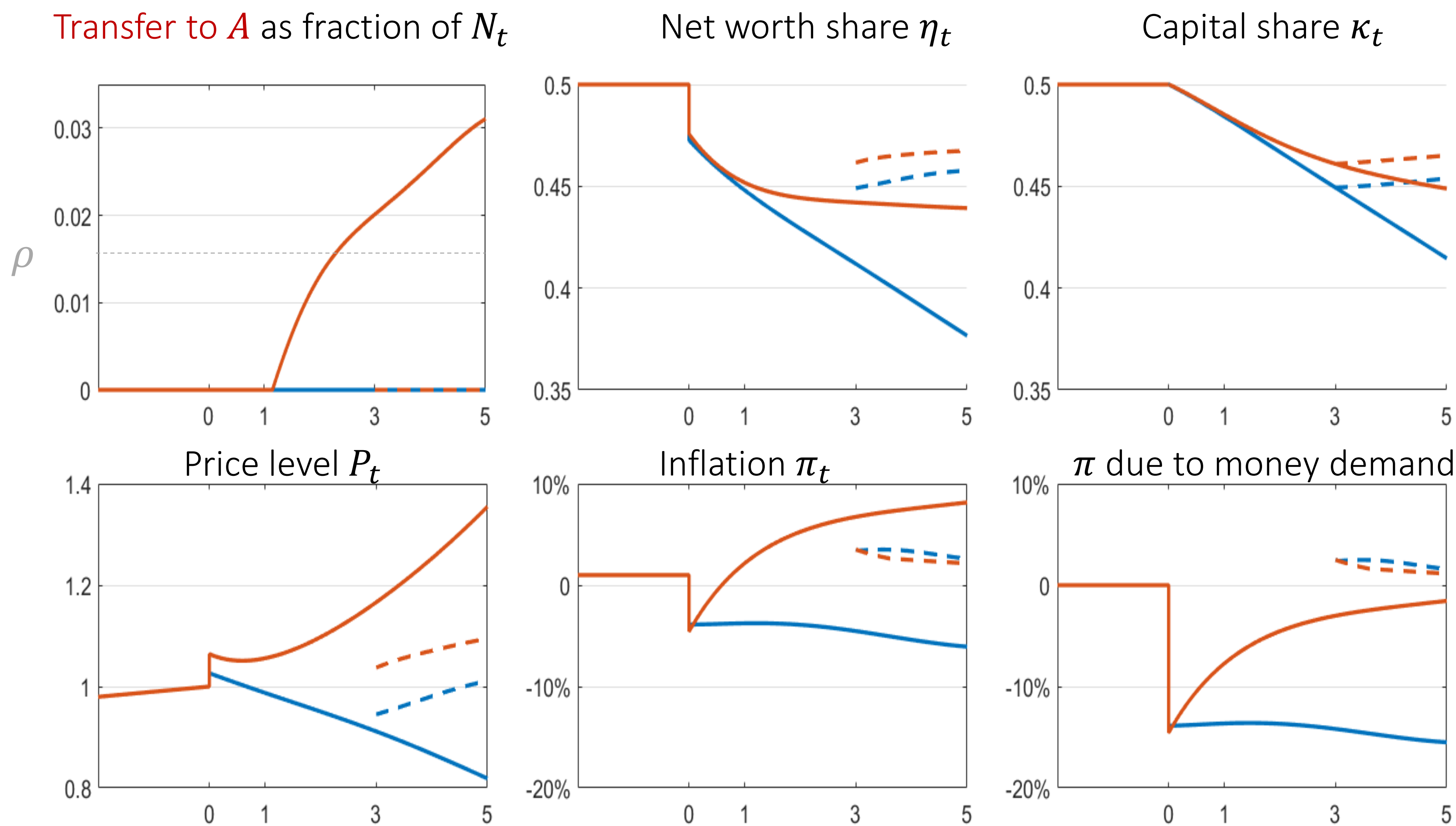
- Removes borrowing constraint $\theta_t^{M,A} \geq 0$

Policy in red
Benchmark in blue



Intratemporal redistributive policy

- Transfers to sector A from sector B (∝ to net worth)



Intertemporal redistribution+fiscal debt

- Transfers to sector A are funding with government debt + future taxes (on sector B starting with recovery phase forever)
  If
  i. + lending policy added (removes borrowing constraint)
  ii. Lump sum tax on B

  Ricardian Equivalence ⇔ Intratemporal redistribution

- Alternative tax schemes:
  - Tax on A in the future
  - Tax proportional net worth — partially insures idio-risk (for B) ⇒ less money demand

Intertemporal redistribution+monetization

- Transfer to sector A funding with future “inflation tax”
- Policy space is very limited
  - Needs more serious calibration – future work!

- Need model in which with existing <u>long-term</u> debt can be wiped out

Conclusion

- Many inflationary and deflationary pressures
  - Simple model with rich implications
    - Lending programs, redistribution, gov. debt, monetization, …
  - Rich inflation dynamics
    ''smoothed out'' for measured inflation or price stickiness

- Assumptions to be relaxed: - to do list! -
  - Full price flexibility
  - Government debt is default free and no competing safe asset
    - No flight-to-safety into competing currency (see BruSan "International…")
  - Government debt is predictable / perfect commitment
    - UK 1920-25: fiscal policy to return to gold standard
    - Germany 1920: Matthias Erzberger's fiscal tax plan failed
  - Demand vs. supply shock (α_t instead of a_t)

Brunnermeier, Merkel, Payne & Sannikov

Thank YOU!

Backup slide

- Seignorage is distributed
  1. Proportionally to money holdings
     - No real effects, only nominal
  2. Proportionally to capital holdings
     - Money return decreases with dM_t (change in money supply)
     - Capital return increases
     - Pushes citizens to hold more capital
  3. Proportionally to net worth
     - Fraction of seignorage goes to capital - same as 2.
     - Rest of seignorage goes to money holders - same as 1.
  4. Per capita
     - No real effects – people simply borrow against the transfers they expect to receive