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

UK Budget Surpluses, Nominal Interest Rate and Inflation
1680-2018

Source: ukpublicrevenues.co.uk, MeasuringWorth.com, Young (1925), Maddison (2010), Schmelzing (2020)
UK vs Germany after WWI

- War financing $\approx \neq$ COVID (GDP and G)

US: inflation-fiscal link + wars

US Budget Surplus, Nominal Interest Rate and Inflation
1860-2018

Source: FRED, MeasuringWorth.com, Mitchell (1908)
US Inflation expectations now

- TIPS: 10 year break even

![Graph showing US 10-Year Breakeven Inflation Rate with a value of approximately 1.1%]

**US 10-Year Breakeven Inflation Rate**

≈ 1.1%
Overview

- Historical examples

- Model setup
  - Uninsurable idiosyncratic risk on capital
    \[ r^K > g > r^f \] is depressed

- Solutions
  - Steps for all phases
  - Phase by phase

- Dissection inflation/deflation forces

- Policy measures and inflation
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- Pecuniary externality
- Inefficiency
- $r < r^*, K > K^*$
- $r > r^*, K < K^*$

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

- 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)
- 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 $\tilde{i}$'s preferences

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

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

**Sector A**

- Output:

$$y_t^{A\tilde{i}} = a_t^A k_t^{I\tilde{i}}$$

- Physical capital:

$$\frac{dk_t^{A\tilde{i}}}{k_t^{A\tilde{i}}} = (\Phi(t_t^A) - \delta)dt + \tilde{\sigma}_t d\tilde{Z}_t^{A\tilde{i}} + d\Delta_t^{k,A\tilde{i}}$$

  - Investment is in CES-composite good

**Sector B**

- Output:

$$y_t^{B\tilde{i}} = \bar{a} k_t^{B\tilde{i}}$$

- Physical capital:

$$\frac{dk_t^{B\tilde{i}}}{k_t^{B\tilde{i}}} = (\Phi(t_t^B) - \delta)dt + \bar{\sigma}_t d\tilde{Z}_t^{B\tilde{i}} + d\Delta_t^{k,B\tilde{i}}$$

**Financial Frictions:**

- Agents cannot share $d\tilde{Z}_t^{I\tilde{i}}$

  $\Rightarrow$ gives value to money/gov. debt

- Borrowing constraint $\theta^M_{t\tilde{i}} > -\bar{\theta}^M$
Shocks: Pandemic + Recovery

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

- Output:
  \[ y_t^A = a_t^A k_t^L, \quad y_t^B = \bar{a} k_t^B \]

\[ a_t^A \text{ or } \alpha_t^A \]
Shocks: Pandemic + Recovery

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

- Output:
  \[ y_t^{A\tilde{a}} = a_t^A k_t^{I\tilde{a}}, \quad y_t^{B\tilde{a}} = \tilde{a} k_t^{B\tilde{a}} \]

\( a_t^A \) or \( \alpha_t^A \)

\[ a_t \]

\[ \tilde{a} \]

Pre-Pandemic

Pandemic

random length \( \lambda e^{-\lambda t} \)

Recovery phase

Sector A

\( q_t^A k_t^{A\tilde{a}} \)

Net worth

\( n_t^{A\tilde{a}} \)

Money

Gov.debt

Sector B

\( q_t^B k_t^{B\tilde{a}} \)

Net worth

\( n_t^{B\tilde{a}} \)

Money

Gov.debt

Sector A

\( q_t^A k_t^{A\tilde{a}} \)

Debt

\( n_t^{A\tilde{a}} \)

Money

Gov.debt

Sector B

\( q_t^B k_t^{B\tilde{a}} \)

Debt

\( n_t^{B\tilde{a}} \)

Money

Gov.debt

Net worth
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

- Intertemporal gov. budget constraint contains bubble term
  - “FTPL with a Bubble”
Some notation

- **Levels**

\[ K_t = K_t^A + K_t^B \]
\[ N_t = N_t^A + N_t^B \]
\[ q_t^K = \kappa_t q_t^A + (1 - \kappa_t) q_t^B \]
\[ N_t = q_t^K K_t + q_t^M K_t \]

- **Shares**

\[ \kappa_t = \frac{K_t^A}{K_t}, \quad \eta_t = \frac{N_t^A}{N_t}, \quad \varphi_t = \frac{\kappa_t q_t^A}{q_t^K} \]
\[ \vartheta_t = \frac{q_t^M}{(q_t^K + q_t^M) K_t} \]

Assumption:

\[ \tilde{\sigma}_t = \tilde{\sigma}(\kappa_t) + \]  

Nominal wealth share (portfolio)

Solve model in shares

Translate back in levels

- **Composite good** (consider intermediary goods sector)

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

- **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 $\iota_t^I$ (in composite good) in Sector $I$

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

  $$\frac{1}{q_t^I} = \Phi'(\iota_t^I) \quad \text{Tobin’s q}$$

  All agents $\iota_t^{I^*} = \iota_t^I$

  Special functional form:

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

Evolution of capital share $\kappa$

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

- Optimal investment rate $\iota_t^I$
  \[ \iota_t^I = \frac{1}{\phi}(q_t^I - 1) \]

- Optimal consumption
  \[ c_t^I = \rho n_t^I \]

- Optimal portfolio \((\theta_t^{M,I}, \theta_t^{K,I})\)
  \[ \theta_t^{M,A} = \ldots \]
  \[ \theta_t^{M,B} = \ldots \]
Optimal choices & aggregation

- Optimal investment rate $\iota_t$
  
  \[ \iota_t = \frac{1}{\phi} (q_t^I - 1) \]

- Optimal consumption
  
  \[ c_t^{I\tilde{}} = \rho n_t^{I\tilde{}} \Rightarrow C_t = \rho (N_t^A + N_t^B) \]

\[ \rho \left[ (q_t^A \kappa_t + q_t^B (1 - \kappa_t)) + q_t^M K_t \right] = q_t^K \]

Value of Money/gov. debt

- Optimal portfolio $(\theta_t^{M,I}, \theta_t^{K,I})$
  
  \[ \theta_t^{M,A} = \ldots \]

  \[ \theta_t^{M,B} = \ldots \]

Let’s solve optimal portfolio later.
Optimal choices & aggregation

- Optimal investment rate $i_t^I$
  \[ i_t^I = \frac{1}{\phi}(q_t^I - 1) \]

- Optimal consumption
  \[ c_t^{I\tilde} = \rho n_t^{I\tilde} \Rightarrow C_t = \rho(N_t^A + N_t^B) \]
  \[ \rho \left[ (q_t^A \kappa_t + q_t^B (1 - \kappa_t)) + q_t^M \right] K_t = q_t^K \]

- Optimal portfolio $(\theta_t^{M,I}, \theta_t^{K,I})$
  \[ \theta_t^{M,A} = \ldots \left[ \theta_t^{M,A} \eta_t + \theta_t^{M,B} (1 - \eta_t) \right] N_t \]
  \[ \theta_t^{M,B} = \ldots \]
  Let’s solve optimal portfolio later.
Optimal choices & market clearing

- Optimal investment rate \( \iota_t^I \)

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

- Optimal consumption

\[
c_t^I = \rho n_t^I \Rightarrow C_t = \rho(N_t^A + N_t^B)
\]

\[
\rho \left[ (q_t^A \kappa_t + q_t^B (1 - \kappa_t)) + q_t^M \right] K_t = (\mathcal{A}_t - \iota_t) K_t
\]

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

\[
\theta_t^{M,A} = \ldots \quad \left[ \theta_t^{M,A} \eta_t + \theta_t^{M,B} (1 - \eta_t) \right] N_t = q_t^M K_t
\]

\[
\theta_t^{M,B} = \ldots
\]

Let’s solve optimal portfolio later.
Optimal $\iota +$ goods market

- Price of physical composite capital
  
  \[ q^K_t = (1 - \vartheta_t) \frac{1 + \phi \mathcal{A}(\kappa_t; a^A_t)}{(1 - \vartheta_t) + \phi \rho} \]

- Real value of money per unit of $K_t$
  
  \[ q^M_t = \vartheta_t \frac{1 + \phi \mathcal{A}(\kappa_t; a^A_t)}{(1 - \vartheta_t) + \phi \rho} \]

- Moneyless equilibrium: $q^M_t = 0 \Rightarrow \vartheta_t = 0 \Rightarrow q^K_t = \frac{1 + \phi \mathcal{A}(\kappa_t; a^A_t)}{1 + \phi \rho}$
  
  - Real value of government debt is fragile!
Drifts

- $\mu^K_t = \kappa_t \Phi(l_t^A) + (1 - \kappa_t) \Phi(l_t^B) - \delta$
- $\mu^K_t = (1 - \kappa_t) \left( \Phi(l_t^A) - \Phi(l_t^B) \right) = (1 - \kappa_t) \log(q_t^A/q_t^B)$
- $\mu^n_t = (1 - \eta_t)((\text{risk premium}) \theta^K_{t,A} - (\text{risk premium}) \theta^K_{t,B})$
- $\mu^\phi_t = (1 - \phi_t) \left( \mu_t^q - \mu_t^q + \frac{\mu^K_t}{1 - \kappa_t} \right)$

Money demand

- $\mu^\vartheta_t = \rho - (1 - \vartheta_t)^2 \tilde{\sigma}_t^2 \left( \frac{\phi^2}{\eta_t} + \frac{(1 - \varphi)^2}{1 - \eta_t} \right) + (1 - \vartheta_t) \left( \mu^M_t - i_t \right)$
  
  + $\lambda(1 - \vartheta_t)(\text{weighted jump-risk premium})$
  - $(1 - \vartheta_t) \left( \psi_t^A - \psi_t^B \right)$

  Lagrange multiplier
  borrowing constr.
**Drifts**

- $\mu^K_t = \kappa_t \Phi(l^A_t) + (1 - \kappa_t) \Phi(l^B_t) - \delta$
- $\mu^K_t = (1 - \kappa_t) \left( \Phi(l^A_t) - \Phi(l^B_t) \right) = (1 - \kappa_t) \log(q^A_t / q^B_t)$
- $\mu^\eta_t = (1 - \eta_t)(\text{(risk premium)} \theta^{K,A}_t - \text{(risk premium)} \theta^{K,B}_t)$
- $\mu^\varphi_t = (1 - \varphi_t) \left( \mu^q_t q^A_t - \mu^q_t q^A_t + \frac{\mu^K_t}{1 - \kappa_t} \right)$

Money demand

- $\mu^\vartheta_t = \rho - (1 - \vartheta_t)^2 \bar{\sigma}_t^2 \left( \frac{\varphi^2}{\eta_t} + \frac{(1 - \varphi)^2}{1 - \eta_t} \right) + (1 - \vartheta_t) \left( \mu^M_t - i_t \right) + \lambda(1 - \vartheta_t)(\text{weighted jump-risk premium})$
- $-(1 - \vartheta_t) \left( \psi^A_t - \psi^B_t \right)$

"inflation tax" 

$\bar{\mu}_t^M :=$ weighted idio-risk premium

borrowing constr.
Drifts

- \( \mu^K_t = \kappa_t \Phi(l^A_t) + (1 - \kappa_t)\Phi(l^B_t) - \delta \)
- \( \mu^K_t = (1 - \kappa_t) \left( \Phi(l^A_t) - \Phi(l^B_t) \right) = (1 - \kappa_t) \log(q^A_t / q^B_t) \)
- \( \mu^\eta_t = (1 - \eta_t)((\text{risk premium})\theta^K,A_t - (\text{risk premium})\theta^K,B_t) \)
- \( \mu^\varphi_t = (1 - \varphi_t)(\mu^q_t - \mu^q_t + \frac{\mu^K_t}{1 - \kappa_t}) \)

Money demand

- \( \mu^\theta_t = \rho - (1 - \vartheta_t)^2 \tilde{\sigma}^2 \left( \frac{\varphi^2}{\eta_t} + \frac{(1 - \varphi)^2}{1 - \eta_t} \right) + (1 - \vartheta_t)(\mu^M_t - i_t) \)

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

Portfolio distortion due to inflation tax

"payoff"

"inflation tax"

Insurance service flow
Overview

- Historical examples
- Model setup
- Solutions for all phases

Phase by phase
  1. Pre-pandemic
  2. Pandemic
  3. Recovery

Policy and inflation
I. Phase: Non-pandemic SS

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

\[ 0 = \mu_t^\kappa = (1 - \kappa_t)\log(q_t^A / q_t^B) \Rightarrow q_t^A = q_t^B \Rightarrow \varphi^{SS} = \kappa^{SS} = \frac{1}{2} \]

\[ 0 = \mu_t^\eta = (1 - \vartheta)^2 \tilde{\sigma}^2_t \left( \frac{\varphi^2}{\eta_t} + \frac{(1-\varphi)^2}{1-\eta_t} \right) (1 - \eta_t)\eta_t \Rightarrow \varphi^{SS} = \eta^{SS} = \frac{1}{2} \]

\[ 0 = \mu_t^\varphi = (1 - \varphi_t)(\mu_t^\varphi - \mu_t^q + \frac{\mu_t^\kappa}{1-\kappa_t}) \Rightarrow p_{t,SS}^A = p_{t,SS}^B \]

\[ 0 = \mu_t^\vartheta = \rho - (1 - \vartheta)^2 \tilde{\sigma}^2_t \left( \frac{\varphi^2}{\eta} + \frac{(1-\varphi)^2}{1-\eta} \right) + (1 - \vartheta)(\mu^M - i) \]

\[ \Rightarrow 1 - \vartheta^{SS} = \frac{\sqrt{\rho + \bar{\mu}^M}}{\tilde{\sigma}(\kappa^{SS})} \]
### I. Phase: Non-pandemic SS

#### Moneyless equilibrium

<table>
<thead>
<tr>
<th>$q_0^M$</th>
<th>$q_0^K$</th>
<th>$q_0^\lambda$</th>
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<tbody>
<tr>
<td>$0$</td>
<td>$1 + \phi \bar{a}$</td>
<td>$\frac{\bar{a} - \rho}{1 + \phi \rho}$</td>
</tr>
</tbody>
</table>

#### Money equilibrium

<table>
<thead>
<tr>
<th>$q^M$</th>
<th>$q^K$</th>
<th>$\iota^A = \iota^B$</th>
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<tbody>
<tr>
<td>$\frac{(\bar{\sigma} - \sqrt{\rho + \bar{\mu}^M})(1 + \phi \bar{a})}{\sqrt{\rho + \bar{\mu}^M + \phi \bar{\sigma} \rho}}$</td>
<td>$\frac{\sqrt{\rho + \bar{\mu}^M}(1 + \phi \bar{a})}{\sqrt{\rho + \bar{\mu}^M + \phi \bar{\sigma} \rho}}$</td>
<td>$\frac{\bar{a} \sqrt{\bar{\mu}^M - \bar{\sigma} \rho}}{\sqrt{\bar{\mu}^M + \phi \bar{\sigma} \rho}}$</td>
</tr>
</tbody>
</table>

For $\mu^M = i \Rightarrow \ddot{\mu}^M = 0$

(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
      - $\iota$ 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 $\eta$
     - $C^A = \rho N^A$ jumps

2. Deterministic convergence to SS (only idiosyncratic risk)
   - $a_t^A$ converges back to $\bar{a}$ (exogenously)
   - $\varphi_t$ converges back to SS: $\varphi^{SS} = 1/2$
   - $\kappa_t$ 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 \( \eta_t \) declines as pandemic drags on
      - \( \kappa_t \) declines \( \Rightarrow \tilde{\sigma}_t \) rises
    - At some point borrowing constraint starts binding

\[
\mu_t^g = \rho - (1 - \vartheta_t)^2 \tilde{\sigma}_t^2 \left( \frac{\varphi^2}{\eta_t} + \frac{(1-\varphi)^2}{1-\eta_t} \right) + (1 - \vartheta_t)(\mu_t^M - i_t) \\
+ \lambda(1 - \vartheta_t)(\text{weighted jump-risk premium})
\]

\[-(1 - \vartheta_t) \left( \psi_t^A - \psi_t^B \right) \quad \text{Lagrange multipl. borrowing constr.}
\]

- **At \( t = 0 \):** COVID shock (zero probability)
II. Pandemic phase

- **For** \( t > 0 \): Aggregate recovery arrival jump risk
  - Sector A “gambles on recovery”
    - Holds on capital
    - Consumes and net worth share \( \eta_t \) declines as pandemic drags on
      - \( \kappa_t \) declines \( \Rightarrow \sigma_t \) rises
    - At some point borrowing constraint starts binding
      - Affects already equilibrium before it binds

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

\[
\vartheta_t = E_t \int_{t}^{\infty} e^{-\rho(s-t)} \{ (1 - \vartheta_s)(i - \mu_s^M) + (1 - \vartheta_s)^2 \left( \frac{\varphi_s^2}{\eta_s} + \frac{(1 - \varphi_s)^2}{1 - \eta_s} \right) \bar{\sigma}_s^2 \} \vartheta_s ds
\]
Time path after COVID shock/recovery shock

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

Price Level $P_t$

Inflation $\pi_t$

$\pi_t = i$

$\mu^M = i$
Dissecting inflation pressures

- Value of a coin: \( \frac{q_t^M K_t}{M_t} \)  
  Price level: \( P_t = \frac{M_t}{q_t^M K_t} \)

- \( \pi_t = \mu_t^M - \mu_t^K - \mu_t^q \)
  - \( \mu_t^K = \kappa_t \Phi(l_t^A) + (1 - \kappa_t) \Phi(l_t^B) - \delta \)  
    capital factor growth rate
  - \( \mu_t^q = \frac{\phi A(\kappa_t; a_t^A)}{(1-\vartheta_t)+\phi\rho} \mu_t^A(\kappa_t; a_t^A) + \frac{1+\phi\rho}{(1-\vartheta_t)+\phi\rho} \mu_t^\vartheta \) (from \( q_t^M = \vartheta_t \frac{1+\phi A(\kappa_t; a_t^A)}{(1-\vartheta_t)+\phi\rho} \))

- \( \pi_t = +\mu_t^M \)
  - \( (\kappa_t \Phi(l_t^A) + (1 - \kappa_t) \Phi(l_t^B) - \delta) \)
  - \( \frac{\phi A(\kappa_t; a_t^A)}{(1-\vartheta_t)+\phi\rho} \mu_t^A(\kappa_t; a_t^A) \)
  - \( \frac{1+\phi\rho}{(1-\vartheta_t)+\phi\rho} \mu_t^\vartheta \)  
    money printing  
    capital factor growth  
    productivity growth  
    future idio-risk
Dissecting inflation pressures

Price Level $P_t$

Inflation $\pi_t$ (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 $\theta_{t}^{M,A} \geq 0$
Intragtemporal redistributive policy

- Transfers to sector A from sector B ($\propto$ to net worth)

Transfer to $A$ as fraction of $N_t$

Net worth share $\eta_t$

Capital share $\kappa_t$

Price level $P_t$

Inflation $\pi_t$

$\pi$ due to money demand
**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**

- **Alternative tax schemes:**
  - Tax on A in the future
  - Tax proportional net worth partially insures idio-risk (for B)  
  \[ \Rightarrow \text{less money demand} \]

\[ \text{Ricardian } \Leftrightarrow \text{Intratemporal redistribution} \]
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 long-term 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 ($\alpha_t$ instead of $a_t$)
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