Can Deficits Finance Themselves?

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  - "**Self-financing**"—close shortfall via eq'm changes in prices & quantities

Q: how important is such **self-financing**? can there ever be *full* **self-financing**?

How big can "self-financing" be?

Environment: finite lives/liquidity constraints + nominal rigidities

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  Why is the limit one of *exact* self-financing? Keynesian cross arithmetic.

- **Practical relevance**: holds in many environments & quantitatively powerful

  general aggregate demand (incl. HANK), active monetary policy, investment, distortionary taxation, ...

Environment

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  - Unit continuum of OLG households with survival probability $\omega \in (0, 1]$. Nests standard PIH model with $\omega = 1$, and mimics HANK with $\omega < 1$.

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$$c_t = \underbrace{(1-\beta\omega)}_{\text{MPC}} \times \left(\underbrace{d_t}_{\text{wealth}} + \underbrace{\mathbb{E}_t\left[\sum_{k=0}^{\infty} (\beta\omega)^k \left(y_{t+k} - t_{t+k}\right)\right]}_{\text{post-tax income}} \underbrace{-\gamma\mathbb{E}_t\left[\sum_{k=0}^{\infty}(\beta\omega)^k r_{t+k}\right]}_{\text{real rates}} \right) \tag{1}$$

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Key features: (i) elevated MPC + (ii) addt'l discounting of future income & taxes

- **Aggregate supply**
  - Nominal rigidities + union bargaining gives a standard NKPC relation: ▸ Details

$$\pi_t = \kappa y_t + \beta\mathbb{E}_t\left[\pi_{t+1}\right] \quad (2)$$

Policy

- **Monetary policy**
  - Monetary authority responds to output fluctuations:
$$\underbrace{i_t - \mathbb{E}_t\left[\pi_{t+1}\right]}_{\equiv r_t} = \phi \times y_t \tag{3}$$
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  - Issue nominal debt. Log-linearized government budget constraint (in real terms):

$$d_{t+1} = (1+\bar{r}) \times (d_t - \boldsymbol{t_t}) + \frac{\bar{d}}{\bar{y}} r_t - \frac{\bar{d}}{\bar{y}} \left(\boldsymbol{\pi_{t+1} - \mathbb{E}_t\left[\pi_{t+1}\right]}\right) \tag{4}$$

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  - Taxes adjust **gradually** to balance gov't budget, where τ_d parameterizes **delay**:

$$t_t = \underbrace{\tau_d \times (d_t + \varepsilon_t)}_{\text{fiscal adjustment}} + \underbrace{\tau_y y_t}_{\text{tax base financing}} - \underbrace{\varepsilon_t}_{\text{"stimulus checks"}} \tag{5}$$

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For transparent intuition look at H-rule: $\tau_{d,t} = 0$ initially, then $= 1$ after H so $d_{H+1} = 0$.

Equilibrium & sources of financing

- **Eq'm existence & uniqueness** ▸ Full eq'm characterization

Proposition

Suppose that $\omega < 1$ *and* $\tau_y > 0$. *The economy* (1) - (5) *has a unique bounded eq'm.*

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- Our **Q**: how are fiscal deficits in this eq'm financed?
  - From the intertemporal gov't budget constraint:

$$\underbrace{\varepsilon_0}_{\text{deficit}} = \underbrace{\tau_d \times \left(\varepsilon_0 + \sum_{k=0}^{\infty} \beta^k \mathbb{E}_0 (d_k)\right)}_{\text{fiscal adjustment: } (1-\nu)\times\varepsilon_0} + \underbrace{\overbrace{\frac{\bar{d}}{\bar{y}}(\pi_0 - \mathbb{E}_{-1}(\pi_0))}^{\text{debt erosion}} + \overbrace{\sum_{k=0}^{\infty} \beta^k \tau_y \mathbb{E}_0 (y_k)}^{\text{tax base expansion}}}_{\text{self-financing: } \nu\times\varepsilon_0}$$

  - Next: characterize ν as a function of fiscal adjustment delay (τ_d or H)

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1. ***[Monotonicity]*** *It is increasing in the delay of fiscal adjustment (i.e., it is increasing in H and decreasing in τ_d).*

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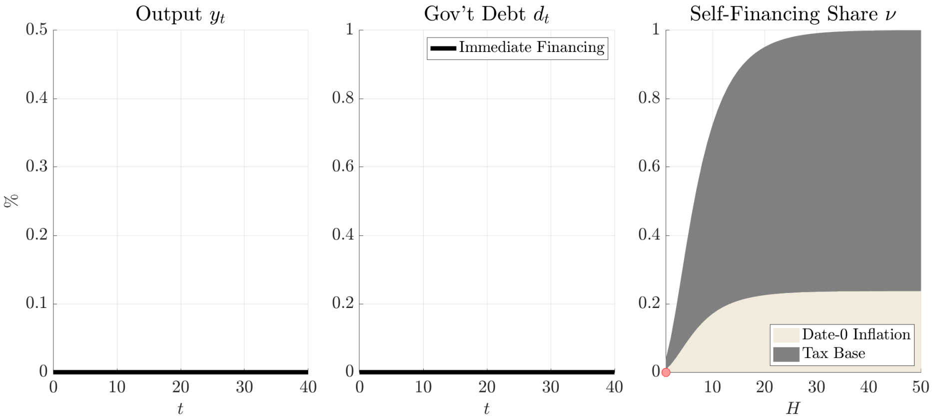
2. ***[Limit]*** *As fiscal financing is delayed more and more (i.e., as $H \to \infty$ or $\tau_d \to 0$), ν converges to 1. In words, delaying the tax hike makes it vanish. In this limiting eq'm:*

   a) *Gov't debt returns to steady state even without any fiscal adjustment:*

   $$\mathbb{E}_t\left[d_{t+1}\right] = \rho_d(d_t + \varepsilon_t), \quad \rho_d \in (0,1)$$

   b) *The share of self-financing coming from the tax base expansion is increasing in the strength of nominal rigidities. With rigid prices the cumulative output multiplier is $\frac{1}{\tau_y}$.*

A graphical illustration



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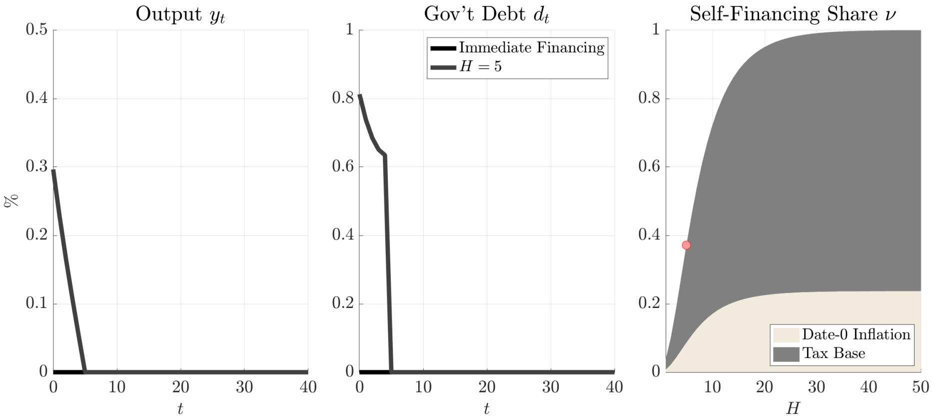

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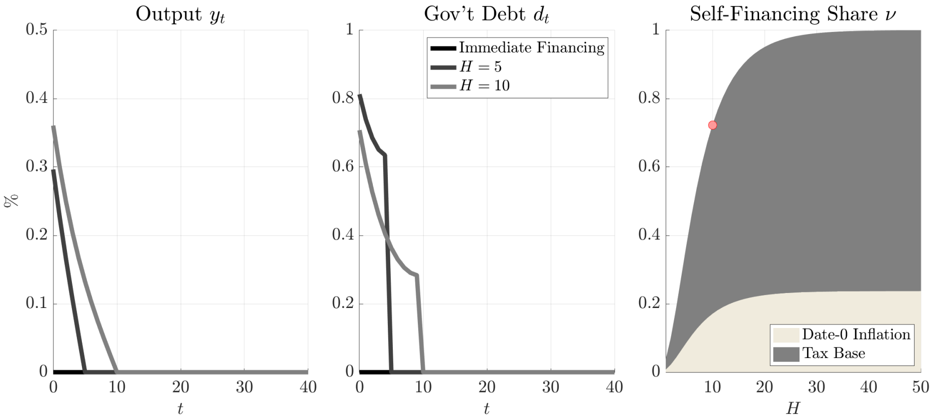

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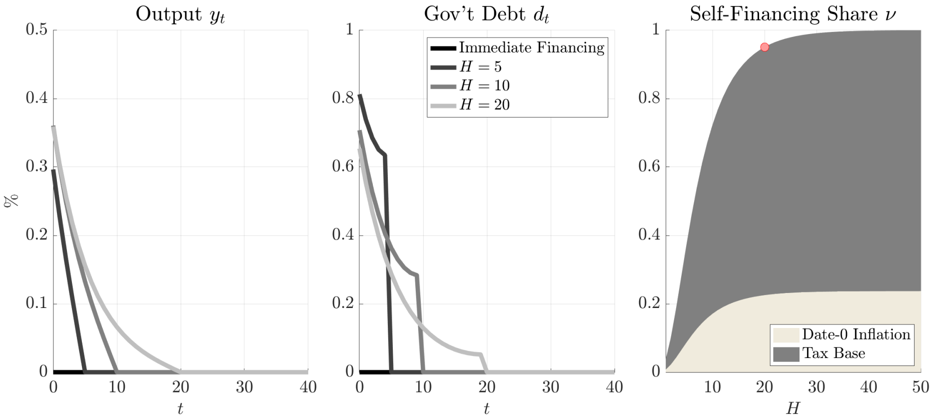

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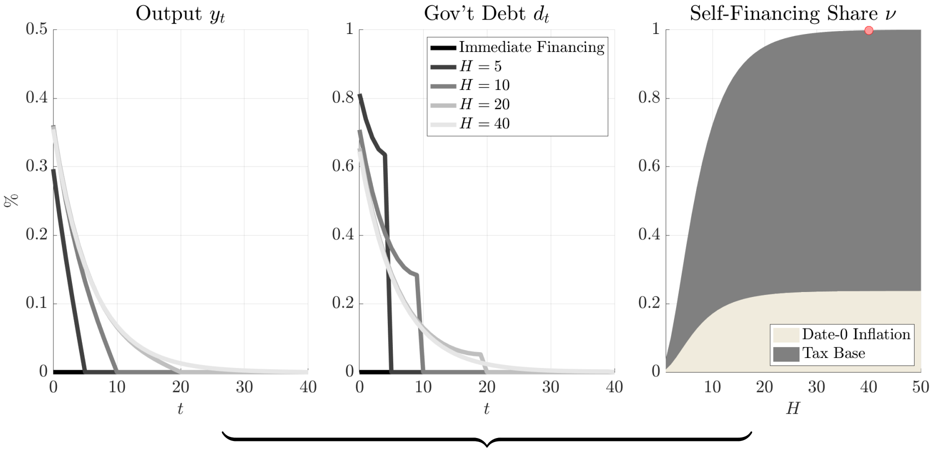

if **fiscal adjustment** is delayed, then financing will come via eq'm **prices & quantities**

The Self-Financing Result

Intuition

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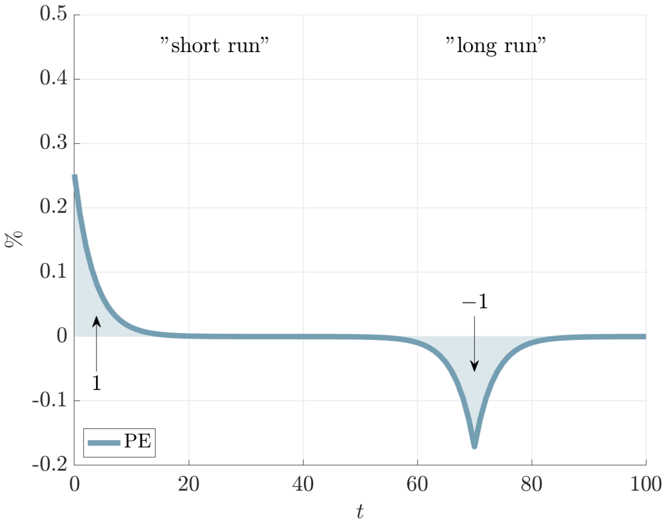

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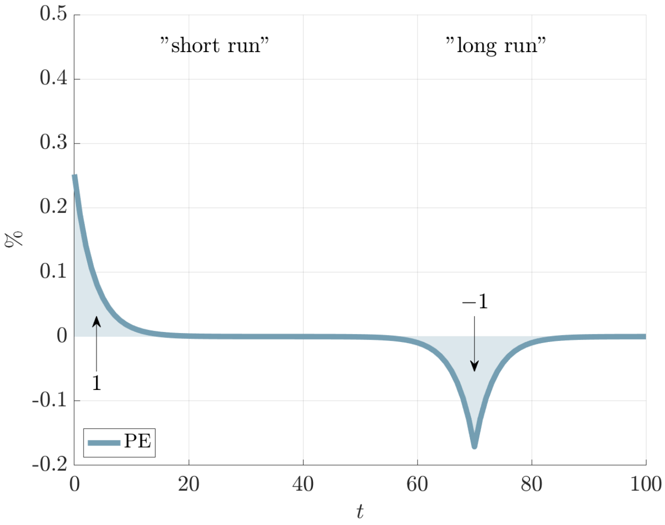

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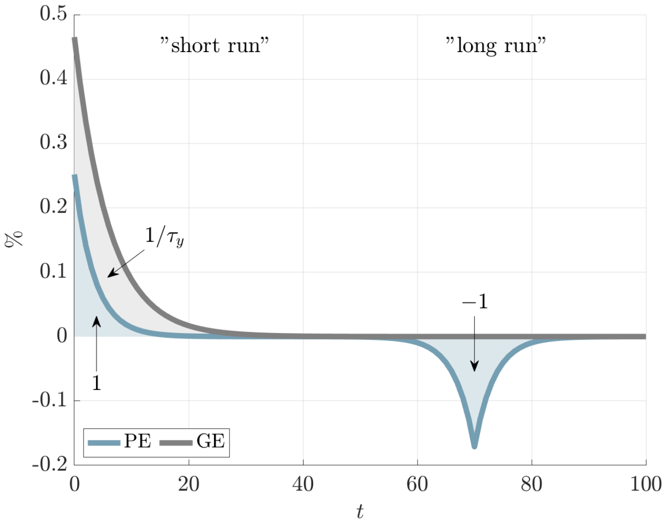

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With imperfectly rigid prices: boom partially leaks into **prices** instead of **quantities**.

Practical Relevance

Extensions & generality

1. **Policy** ‣ Details

   - Fiscal policy: distortionary taxes, gov't purchases
   - **Monetary response**
     - → Intuition: $\phi < 0$ accelerates the Keynesian cross, $\phi > 0$ delays it
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2. **Economic environment** ▸ Details
   - Rest of the economy: different NKPC, wage rigidity, investment
   - **Demand relation**
     - → Need discounting—break Ricardian equivalence + front-load spending
     - → Next: what happens in quantitative model consistent with evidence on consumer demand?

Model & calibration strategy

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  (i) Match evidence on spending responses to lump-sum income receipt
  Later consider alternatives—other calibration targets, behavioral models, and a HANK model.
  (ii) Consider range of τ_d consistent with literature on fiscal adjustment rule estimation
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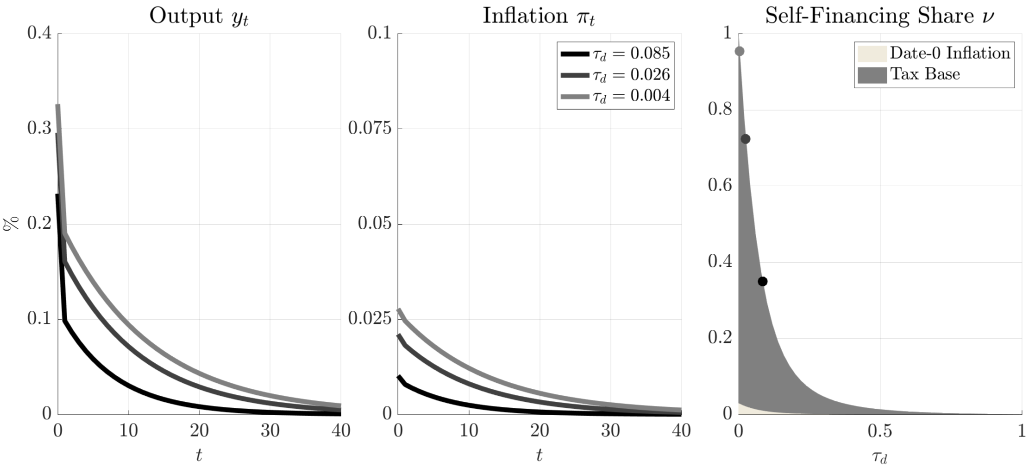
Nominal rigidities: today standard flat NKPC, in paper explore steeper slope.

Self-financing in the quantitative model



▸ Other Experiments

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- **Implications**

  a) **Theory**: grounded in a classical failure of Ricardian equivalence, robust to information perturbations, consistent with Taylor principle, + emphasize y vs. π channel

  b) **Practice**: self-sustaining stimulus may be less implausible than commonly believed
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- **Ongoing work**: (optimal) policy implications for fiscal-monetary interaction

Appendix

Aggregate demand

- **Consumption-savings problem**
  - OLG hh's with survival probability $\omega \in (0,1]$ [can interpret as $\approx$ 1 - prob. of liq. constraint]

$$\mathbb{E}_t \left[\sum_{k=0}^{\infty} (\beta\omega)^k \left[u(C_{i,t+k}) - v(L_{i,t+k}) \right] \right]$$

  - Invest in actuarially fair annuities. Budget constraint:

$$A_{i,t+1} = \underbrace{\frac{I_t}{\omega}}_{\text{annuity}} \left(A_{i,t} + P_t \cdot \left(\underbrace{W_t L_{i,t} + Q_{i,t}}_{Y_{i,t}} - C_{i,t} - T_{i,t} + \text{transfer to newborns} \right) \right)$$

- **Aggregate demand relation**

$$c_t = \underbrace{(1-\beta\omega)}_{\text{MPC}} \times \left(\underbrace{d_t}_{\text{wealth}} + \underbrace{\mathbb{E}_t \left[\sum_{k=0}^{\infty} (\beta\omega)^k (y_{t+k} - t_{t+k}) \right]}_{\text{post-tax income}} \underbrace{- \gamma \mathbb{E}_t \left[\sum_{k=0}^{\infty} (\beta\omega)^k r_{t+k} \right]}_{\text{real rates}} \right) \tag{6}$$

Key features: (i) elevated MPC + (ii) addt'l discounting of future income & taxes

back

Aggregate supply

- **Unions** equalize post-tax wage and average consumption-labor MRS. This gives

$$(1-\tau_y)W_t = \frac{\chi \int_0^1 L_{i,t}^{\frac{1}{\varphi}} di}{\int_0^1 C_{i,t}^{-1/\sigma} di}$$

  Log-linearizing:

$$\frac{1}{\varphi}\ell_t = w_t - \frac{1}{\sigma}c_t$$

- Combining with optimal firm pricing decisions we get the **NKPC**:

$$\pi_t = \kappa y_t + \beta \mathbb{E}_t\left[\pi_{t+1}\right]$$

  - Note: no time-varying wedge since distortionary taxes τ_y are fixed

▸ back

Equilibrium characterization

- First step to eq'm characterization is a more concise representation of agg. demand
- Combining (1), (3), (4), (5), and output market-clearing, we get

$$y_t = \mathcal{F}_1 \cdot (d_t + \epsilon_t) + \mathcal{F}_2 \cdot \mathbb{E}_t \left[\sum_{k=0}^{\infty} (\beta\omega)^k \, y_{t+k} \right] \tag{7}$$

  - Here: $\mathcal{F}_1 \equiv \frac{(1-\beta\omega)(1-\omega)(1-\tau_d)}{1-\omega(1-\tau_d)}$ and $\mathcal{F}_2 = (1-\beta\omega)\left(1 - \frac{(1-\omega)\tau_y}{1-\omega(1-\tau_d)}\right)$
  - Note: $\mathcal{F}_1 = 0$ if $\omega = 1$—reflects lack of direct effect of deficit on consumer spending/ aggregate demand under Ricardian equivalence

- Equilibrium: (2), (7) and law of motion for government debt

▸ back

Equilibrium characterization

- We will look for **bounded equilibria** in the sense of Blanchard-Kahn
  - Note: in our case—with $\omega < 1$ and $\tau_y > 0$—this is enough to rule out sunspot solutions. Recover same eq'm through limit $\phi \to 0^+$.
- The unique bounded eq'm takes a particularly simple form:

$$y_t = \chi(d_t + \varepsilon_t), \quad \mathbb{E}_t\left[d_{t+1}\right] = \rho_d(d_t + \varepsilon_t)$$

where $\chi > 0$ (deficits trigger boom) and $0 < \rho_d < 1$ (debt goes back to steady state).

back

Distortionary fiscal financing

- **Environment**
  - **Fiscal adjustment** now instead through distortionary tax adjustments. Specifically:

$$\tau_{y,t} = \tau_y + \tau_{d,t}(D_t - D^{ss})$$

  - Only effect is to change (2) to

$$\pi_t = \kappa y_t + \beta \mathbb{E}_t \left[\pi_{t+1}\right] + \zeta_t d_t$$

- **Self-financing result**
  - Easy to see: exactly the same limiting self-financing eq'm as before
  - Why? tax adjustment not necessary, so distortionary vs non-distortionary is irrelevant

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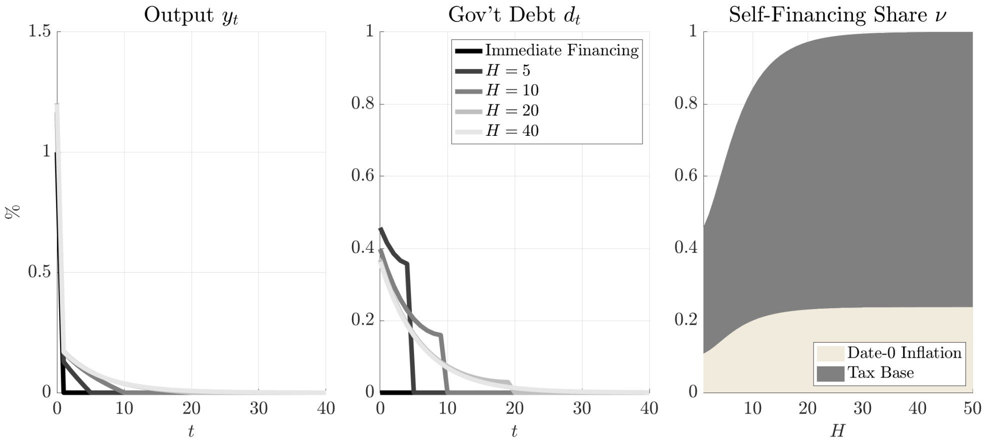
Government purchases



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Monetary policy reaction

- **Intuition**: $\phi < 0$ accelerates the Keynesian cross, $\phi > 0$ delays it

Proposition

There exists a $\bar{\phi} > 0$ such that:

1. *An equilibrium with full self-financing exists if and only if $\phi < \bar{\phi}$.*
2. *The persistence of $\rho_d(\phi)$ of gov't debt (and output) in the equilibrium with full self-financing is increasing in ϕ, with $\rho_d(0) \in (0, 1)$ and $\rho_d(\bar{\phi}) = 1$.*

Note: same logic for standard Taylor-type rules like $i_t = \phi \times \pi_t$.

- What happens if $\phi > \bar{\phi}$? Depends on **fiscal adjustment**:
    - If too delayed then no bounded eq'm exists. For such an aggressive monetary policy fiscal adjustment needs to be *fast enough*.
    - If adjustment is fast enough then there is **partial** but not **complete self-financing**.

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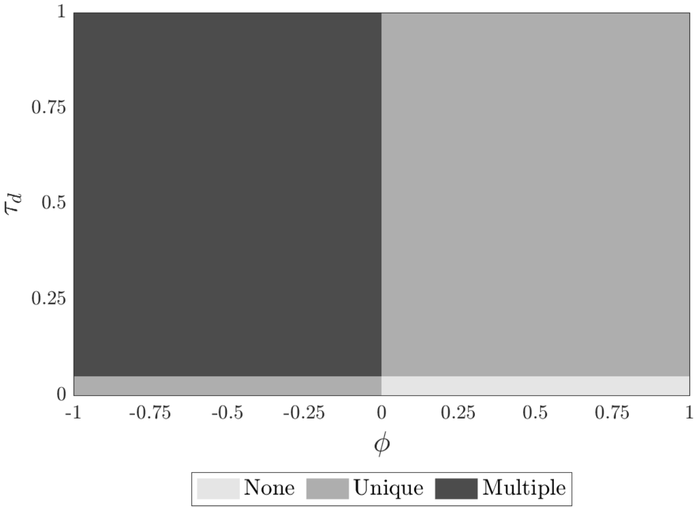
Leeper regions



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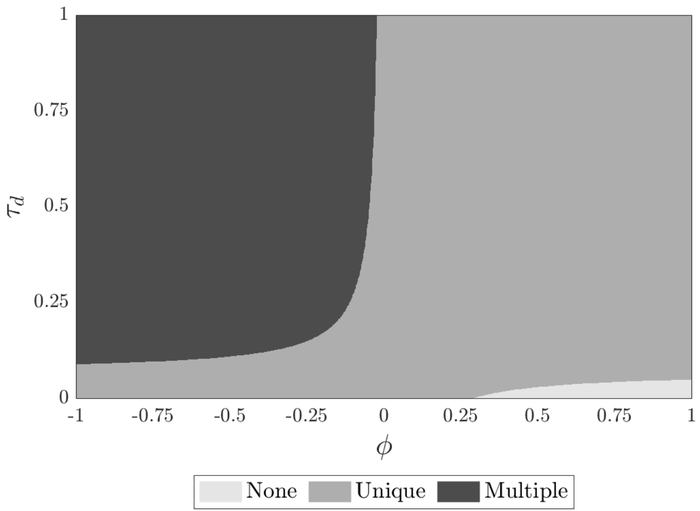
Leeper regions



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A generalized aggregate demand relation

- **Important**: our results are *not* tied to the particular **OLG** microfoundations
- Instead: it's all about two empirically plausible features of **consumer demand**
  1. *Discounting*: households at date $t = 0$ respond little to expectations of far-ahead tax hikes
  2. *Front-loaded spending*: transfer receipt (and higher-order GE income) is spent quickly

  in **OLG** both of these are ensured by $\omega < 1$
- Will formalize this using the following **generalized AD relation**:

$$c_t = M_d d_t + M_y \left(y_t - t_t + \delta \mathbb{E}_t \left[\sum_{k=0}^{\infty} (\beta\omega)^k (y_{t+k} - t_{t+k}) \right] \right)$$

Rich enough to nest PIH, OLG, spender-saver, spender-OLG, behavioral discounting, ... Also can provide very close reduced-form fit to consumer behavior in quantitative HANK models.

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A generalized aggregate demand relation

- **Headline result**: sufficient conditions for **self-financing**

  A1 **Discounting**

  $$\omega < 1$$

  Transfer today and taxes in the future redistribute from future generations to the present.

  A2 **Front-loading**

  $$M_d + \frac{1-\beta}{\tau_y}(1-\tau_y)M_y\left(1+\delta\frac{\beta\omega}{1-\beta\omega}\right) > \frac{1-\beta}{\tau_y}$$

  Self-financing boom is front-loaded enough to deliver $\rho_d < 1$.

- Note: the self-financing result *fails* if there are **PIH households**

  "Deep-pocket" rational investor intuition—infinitely elastic PIH hh's link infinite future & present.

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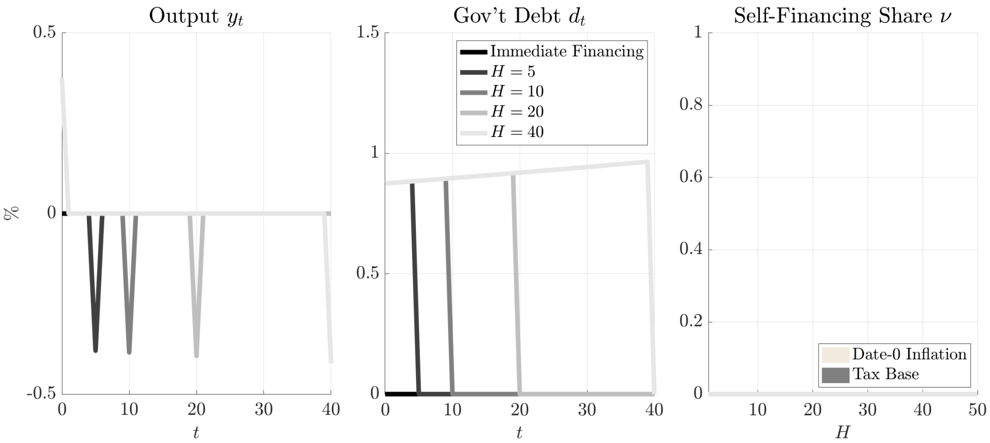
The importance of discounting

spender-saver model



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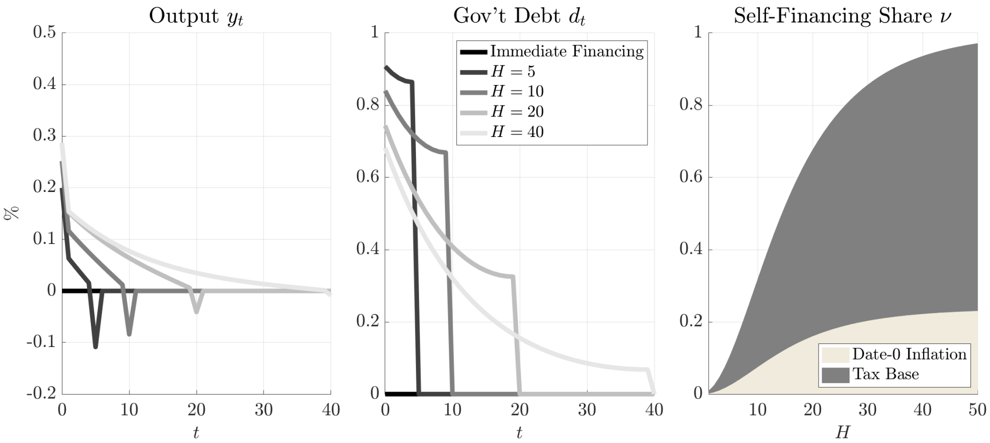
The importance of discounting

hybrid spender-OLG model



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Adding investment

- **Environment**
  - **Households**: receive labor income plus dividends e_t. Pay taxes τ_y on both.
  - **Production**: standard DSGE production block. Key twist: no tax payments anywhere.
- **Self-financing result**
  - For rigid prices exactly the same self-financing eq'm as before. Why? Keynesian cross & gov't budget both have c_t rather than y_t in them, so same pair of equations as before
  - Partially sticky prices: more complicated mapping from $\{c_t\}_{t=0}^{\infty}$ back to π_0, so fixed point is more complicated, but can still show that self-financing eq'm exists
    Perfectly analogous to change in NKPC. Just change mapping into π_0.

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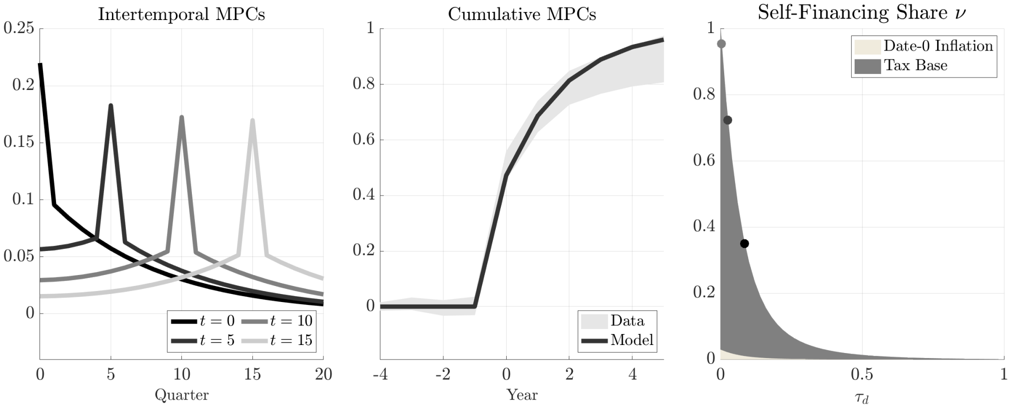
Alternative calibration strategies

Baseline: match impact and short-run MPCs, then extrapolate

Note: also consistent with evidence on long-run elasticity of asset supply.



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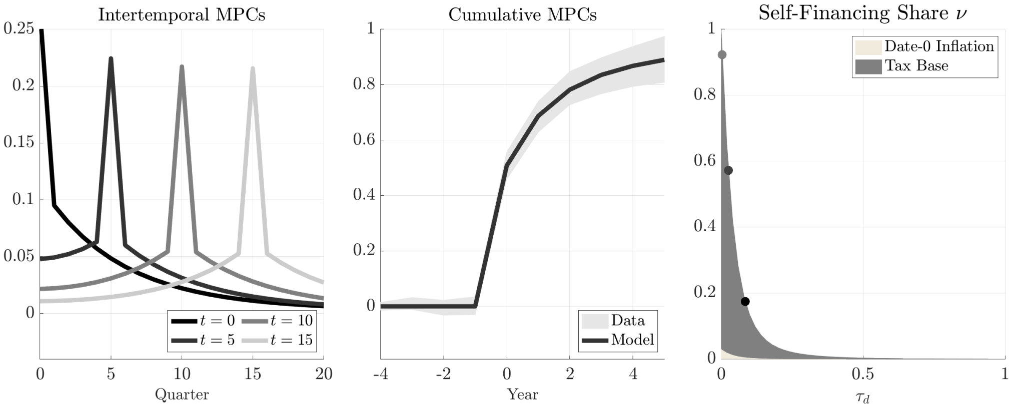
Alternative calibration strategies

Extension: two-type OLG + spender model to match cumulative MPC time profile

This gives $\omega_2 = 0.97$, and thus counterfactually elastic asset supply ($\approx 7x$ emp. upper bound).



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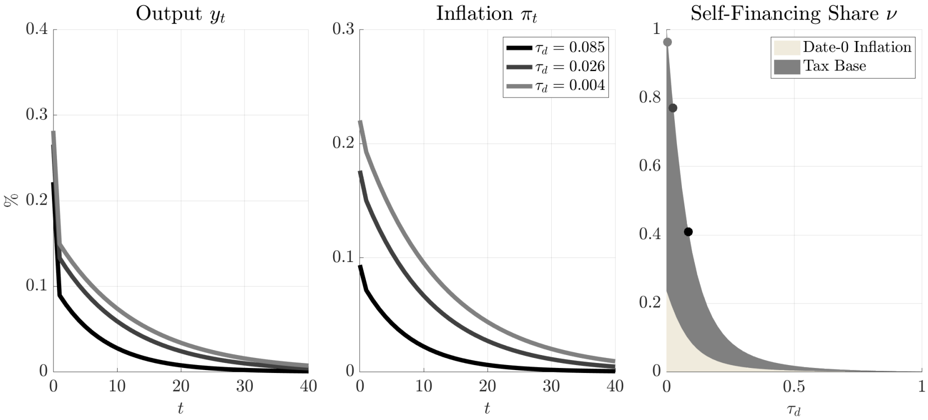
More flexible prices

Steeper NKPC: arguably more informative about post-covid episode

Takeaways: (i) change ν_y/ν_p split & (ii) faster convergence to self-financing limit



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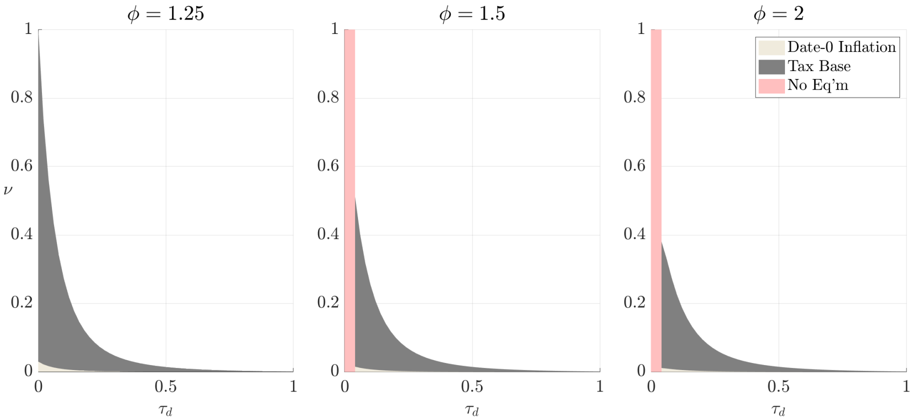
Active monetary policy reaction

Monetary response: consider standard Taylor rule $i_t = \phi \times \pi_t$

Takeaways: (i) slower convergence & (ii) no self-financing eq'm exists for sufficiently large ϕ



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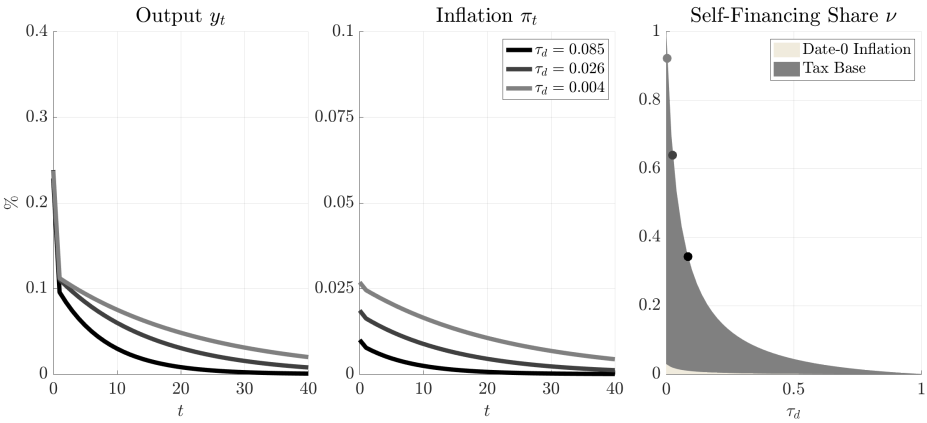
Other models

Environment: baseline + behavioral friction [strong cognitive discounting]



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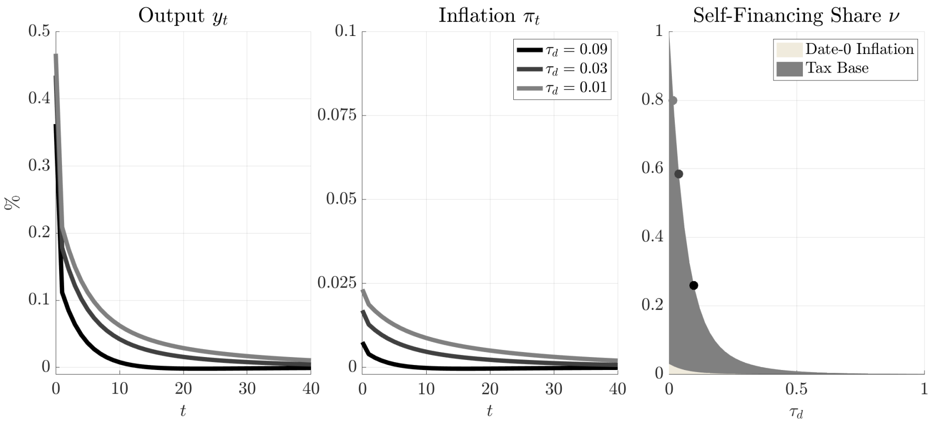
Environment: HANK model [similar to Wolf (2022)]



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