A Goldilocks Theory of Fiscal Deficits

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Understanding the dynamics of debt and deficits

Qs: What are the joint dynamics of debt and deficits? Fiscal cost of higher debt?

- Standard logic: deficits $\uparrow$ today pushes debt $\uparrow$, requires deficits $\downarrow$ tomorrow
- With $R < G$: may never have to $\downarrow$ deficits ("free lunch"), no general condition
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Exciting literature: [Ball-Mankiw, Barro, Bassetto-Sargent, Blanchard, Brumm et al, Brunnermeier et al, Domeij-Ellingsen, Kocherlakota, Lustig et al, Mehrotra-Sergeyev, Reis, Caballero-Farhi+Gourinchas, Farhi-Maggiori, Ono, ...]

Outline

1. Our framework
2. Fiscal space without ZLB
3. Fiscal space with ZLB
4. Quantifying U.S. and Japanese fiscal space

Our framework

Overview

- Deterministic endowment economy, with rationing at ZLB
- Government issues government debt, spends, taxes
- Spenders & savers, savers with **preferences for convenience**
- Monetary authority implements natural allocation unless up against ZLB

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- Deterministic endowment economy, with rationing at ZLB
- Government issues government debt, spends, taxes
- Spenders & savers, savers with **preferences for convenience**
- Monetary authority implements natural allocation unless up against ZLB
- Notation:
  - R_t = net nominal interest rate, $G_t = \gamma + \pi_t$ = net nominal growth rate
  - R_t^* = natural rate achieving inflation target π^*, $G^* = \gamma + \pi^*$
- Will solve **de-trended** version of the model
  - $y^* \equiv 1$ de-trended potential output
  - $R_t - G_t$ de-trended interest rate

Household problem

- Fraction $1-\mu$ savers solve (de-trended) problem

$$\max_{\{c_t, b_t\}} \int_0^\infty e^{-\rho t} \{\log c_t + v(b_t)\}\, dt$$

$$c_t + \dot{b}_t \leq (R_t - G_t)\, b_t + (1-\mu)\, y_t - \tau_t$$

- $b_t =$ government debt to potential GDP
- $v(b_t)$ captures convenience benefits of government bonds
[Krishnamurthy Vissing-Jorgensen 2012, Greenwood Hansen Stein 2015]
    - increasing and concave
- Spenders consume constant share of income μy_t
- $y_t =$ labor endowment, sold to repr. firm. If rationed, $y_t < 1$

- Fiscal policy consists of $\{x, b_t, \tau_t\}$ that satisfy

$$x + (R_t - G_t)\, b_t \le \dot{b}_t + \tau_t$$

$$\text{primary deficit:} \qquad z_t \equiv x - \tau_t$$

Government

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$$R_t = \max\{R_t^*, 0\}$$

- Simple downward nominal wage rigidity [easily generalized]

$$\pi_t = \dot{W}_t / W_t \geq \pi^* - \kappa(1 - y_t)$$

When demand is low, $y_t < 1$ and $\pi_t < \pi^*$

[$\kappa < v'(0)$ avoids Benhabib Schmitt-Grohe Uribe (2001) issues, as in Michaillat Saez (2019)]

Fiscal space without ZLB

Analyzing steady state equilibria

- Begin by analyzing **steady state equilibria**
- For each b, a steady state exists with suitable deficit z that keeps b const:

$$\dot{b}_t = (R_t - G_t)\, b_t + z_t = 0 \quad \Rightarrow \quad z(b) = (G(b) - R(b)) \cdot b$$

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- Without ZLB: $R_t = R^*$, $y_t = 1$, $\pi_t = \pi^*$, $G = G^*$

$$\frac{\dot{c}_t}{c_t} = R^* - G^* - \rho + v'(b_t) c_t$$

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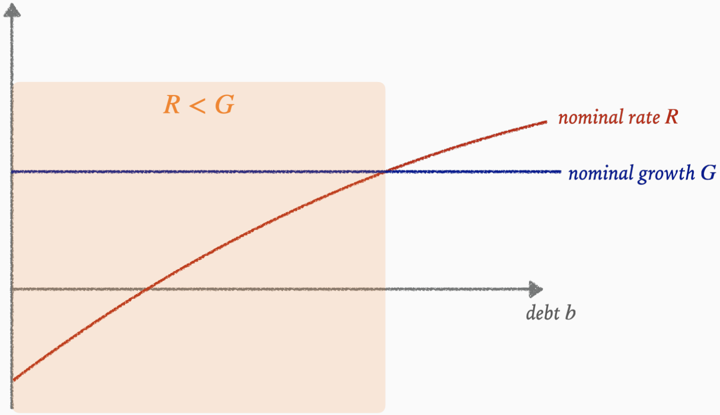
$$\frac{\dot{c}_t}{c_t} = R^* - G^* - \rho + v'(b_t) c_t$$

where $c_t = 1 - \mu - x$, so

$$R^*(b) = G^* + \rho - \underbrace{v'(b)\,(1 - \mu - x)}_{\text{convenience yield}} \qquad G(b) = G^*$$

The deficit debt diagram



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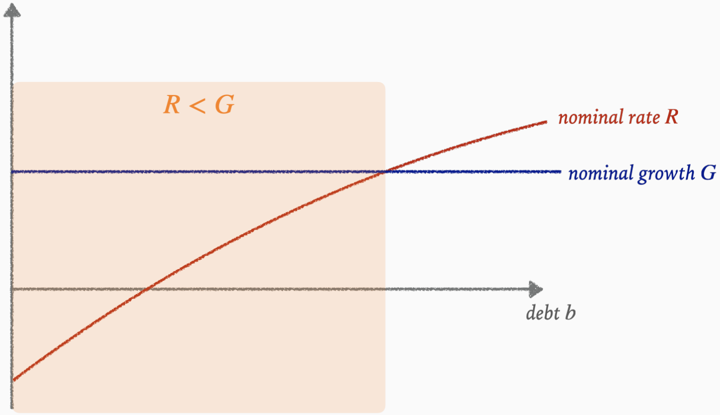

- **Permanent primary deficit** $z = (G - R)\, b > 0$ when $R < G$

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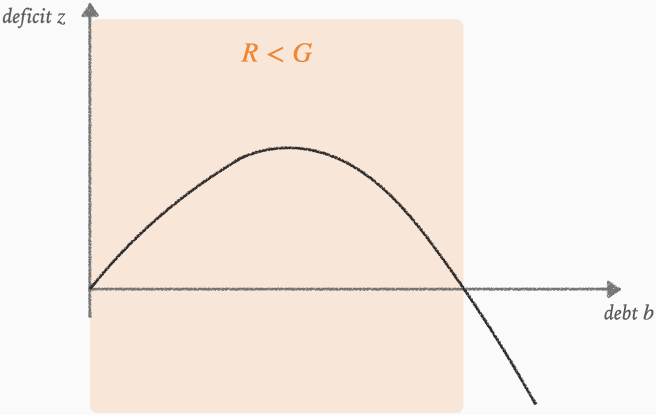


- **Permanent primary deficit** $z = (G - R)\, b > 0$ when $R < G$
- This locus is our way to conceptualize "fiscal space"

When is there a free lunch?

- Common view: when $R < G$, debt is stable

$$\dot{b}_t = (R - G)b_t + z$$

- Suggests that fiscal expansions are a **“free lunch”**:

  raising the deficit now does not require future deficit reductions!

When is there a free lunch?

- Problem: This ignores that R is **endogenous**!

$$\dot{b}_t = (R(b) - G^*)b_t + z$$

Key:

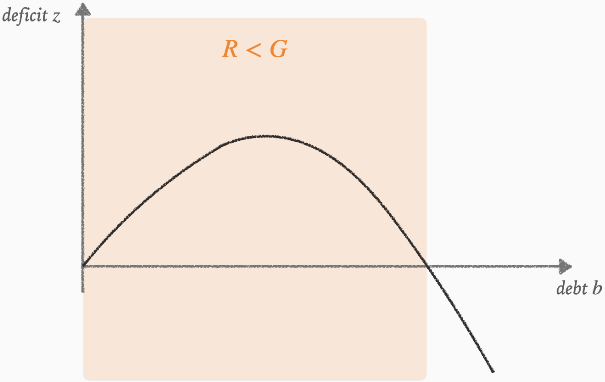
$$\frac{\partial}{\partial b}(R(b) - G^*)b \text{ can be positive despite } R < G\,!$$

- In fact, free lunch only possible if [formalizes logic in Miller Sargent 1984]

$$R < G - \varphi \qquad \text{where} \quad \varphi \equiv \frac{\partial\left(R(b) - G^*\right)}{\partial \log b}$$

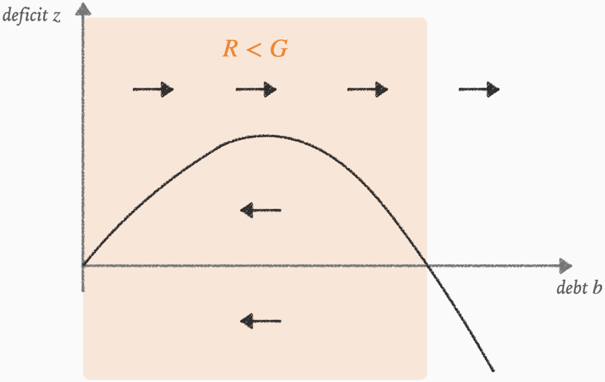
- Free lunch $=$ Pareto improvement [see also Aguiar Amador Arellano 2021]
- Aggregate risk? $\rightarrow$ Paper: Prob(free lunch) arbitrarily close to 1 if $R < G - \varphi$

Free lunch in the deficit debt diagram



Free lunch in the deficit debt diagram

▸ tvc ▸ pv



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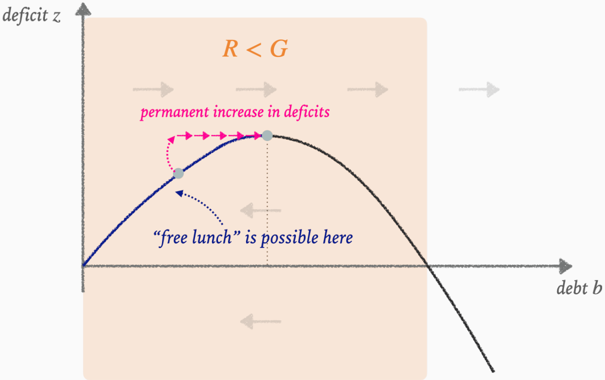

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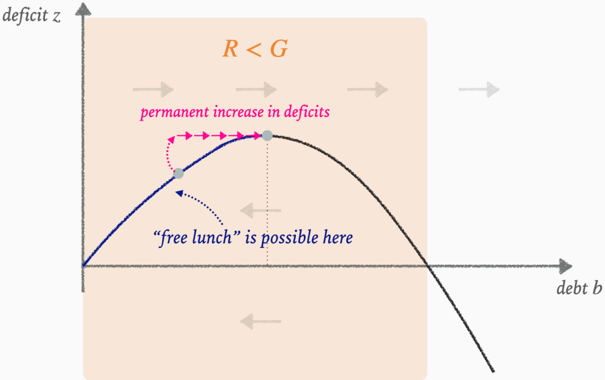

- So far, flow budget constraint ...

Present value vs flow budget constraint

back

- Can always write PV budget constraint. But which interest rate to use?
- No matter which, $R_t = R(b_t)$, so can't get rid of b_t in the budget constraint
- Natural choice: **marginal rate of borrowing** $R(b_t) - G^* + \varphi(b_t)$, hence

$$\int_0^T e^{-\int_0^t (R(b_u)-G^*+\varphi(b_u))du} \left(z_t - \varphi(b_t)b_t\right) dt + b_0 \leq e^{-\int_0^T (R(b_u)-G^*+\varphi(b_u)du} b_T$$

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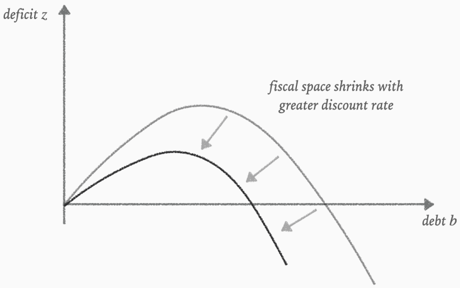
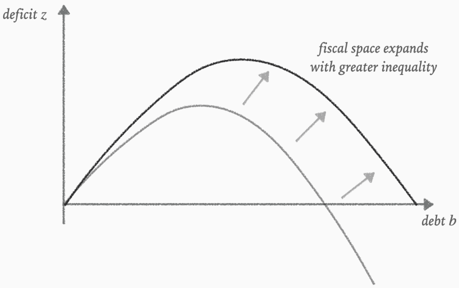
- Locally around **steady state outside free lunch**:

$$\int_0^\infty e^{-(R_{ss} - G + \varphi_{ss})t} z_t dt + b_{ss} \leq \frac{\varphi}{R_{ss} - G + \varphi} b_{ss}$$

Well-defined PV constraint with discount rate $R_{ss} - G + \varphi_{ss}$

What determines fiscal space?





- Fiscal space shrinks with greater discount rate ρ
  - more “aggregate demand” shrinks fiscal space; similar: reduced supply
- Fiscal space rises with greater inequality $1 - \mu$
  - conflict between large deficit-financed programs and reducing inequality?

Fiscal space with ZLB

Steady state equilibria at the ZLB

- Imagine natural rate is negative, $R^*(b) < 0$. Then economy is **at ZLB**.

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$$y_t = c_t + \mu y_t + x$$

where c_t follows Euler equation at ZLB

$$\frac{\dot{c}_t}{c_t} = \underbrace{0 - (G^* - \kappa(1 - y_t))}_{R-G} - \rho + v'(b) c_t$$

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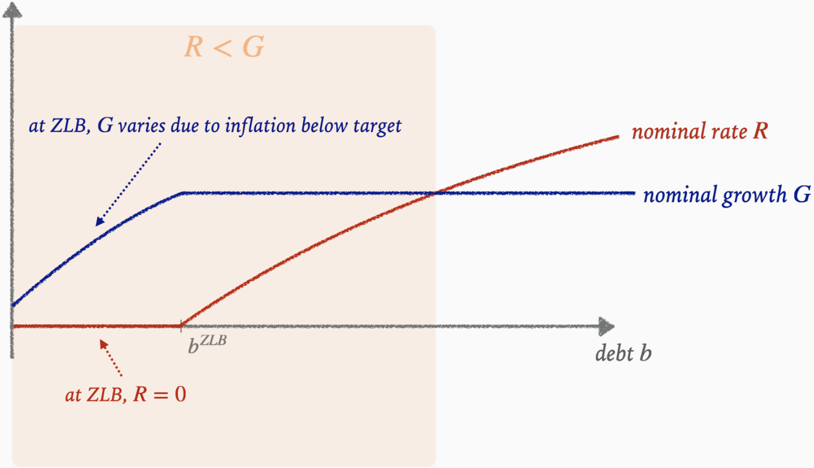
- Find:

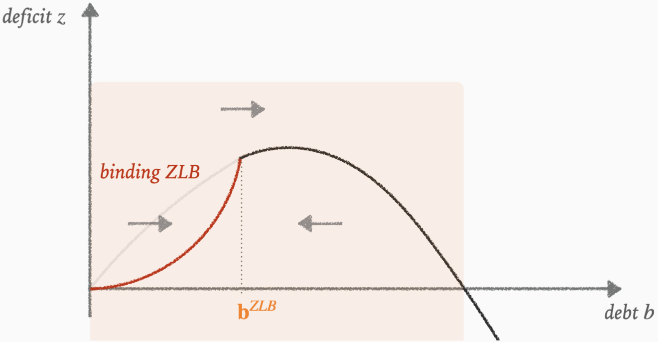
$$R(b) = 0 \qquad G(b) = G^* - \frac{\kappa}{v'(b) - \kappa}(-R^*(b))$$

- Key observation: Now **nominal growth rate** is endogenous!
- Phillips curve slope κ matters for how sensitive $G(b)$ is to b!

Deficit-debt diagram at the ZLB



Deficit-debt diagram at the ZLB



- Less fiscal space at ZLB since (nominal) growth is weaker

  … but always free lunch at ZLB

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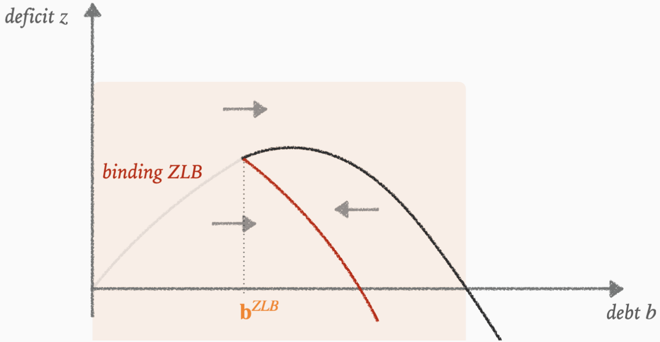
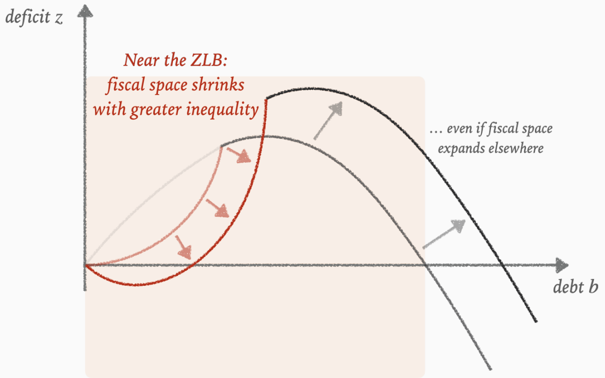


- Less fiscal space at ZLB since (nominal) growth is weaker

  … but always free lunch at ZLB
- Low primary deficits **increase debt** here when $\kappa > \frac{1-\mu}{1-\mu-\chi}(\rho + G^*)$
  - debt stable or falls only in intermediate region (a kind of “Goldilocks zone”)

Inequality and fiscal space at the ZLB



- Inequality can now **decrease** fiscal space, due to weaker nominal growth
- More progressive taxes can **increase** fiscal space, due to higher inflation
- Free lunch region expands

Quantifying U.S. and Japanese fiscal space

Measuring the deficit debt diagram

table Georgia

- Key determinant: shape of convenience yield. Today:

$$(1-\mu-x)v'(b) = (1-\mu-x)v'(b_0) - \varphi\frac{b-b_0}{b_0}, \qquad \varphi \equiv \frac{\partial(R-G)}{\partial \log b}$$

- What is φ? Empirical literature:

$$\varphi \approx 1.2\% - 2.2\%$$

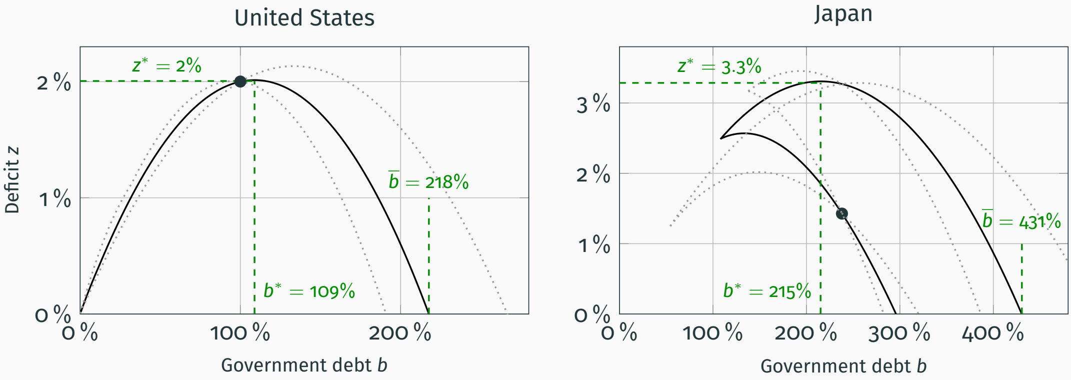
[Krishnamurthy Vissing-Jorgensen 2012, Laubach 2009, Presbitero Wiriadinata 2020, own estimates]

  - pick $\varphi = 1.7\%$ [robustness below]

[1.7 bp $\uparrow$ in $R-G$ for 1% $\uparrow$ in b]

- Calibrate remaining parameters to pre-Covid steady states for Japan and U.S.

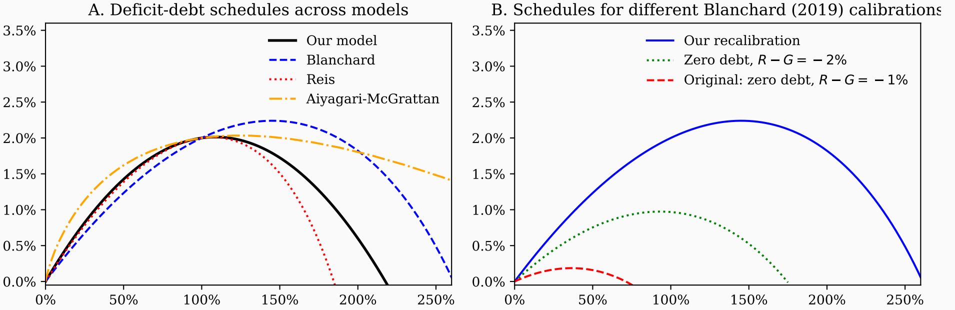
Calibrated deficit debt diagrams



- U.S.: Max deficit is small, we're likely beyond free lunch now, despite $R < G$
- Japan: In backward-bending ZLB part of locus, greater deficits $\Rightarrow G \uparrow$, debt $\downarrow$

U.S.: Comparison across models

▸ K



Takeaway

Standard logic: higher deficits $\Rightarrow$ explosive debt unless deficits cut eventually

- **Free lunch** available if $R < G - \varphi$: debt not explosive!
- **When ZLB is binding:** debt may not even rise at all!
- **Inequality** increases fiscal space outside ZLB, tightens it at ZLB

Extra slides

Transversality condition

back

- The transversality condition in our model is given by

$$e^{-\rho t} c_t^{-1} b_t \to 0$$

- This is clearly satisfied in any equilibrium that ends up on the locus, since $c_t = 1 - x$ and $b_t \to const$ then.

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- Can always write PV budget constraint. But which interest rate to use?
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$$\int_0^\infty e^{-(R_{ss} - G + \varphi_{ss})t} z_t dt + b_{ss} \leq \frac{\varphi}{R_{ss} - G + \varphi} b_{ss}$$

Well-defined PV constraint with

- discount rate $R_{ss} - G + \varphi_{ss}$
- extra present value premium $\frac{\varphi}{R_{ss} - G + \varphi} b_{ss}$

Role of capital

back

- If capital does not benefit from convenience yield $\Rightarrow$ no crowding out
- So let's include capital in v

$$\max_{\{c_t, b_t\}} \int_0^\infty e^{-\rho t} \left\{ \log c_t + v\left(\frac{b_t + k_t}{y_t}\right)\right\} dt$$

  and assume that production function is Cobb-Douglas, $y_t = k_t^\alpha$
- **Result:** Free lunch region is greater with capital

$$R < G - \varphi \times \frac{b/y}{b/y + k/y\left(1 + \frac{\varphi}{R - \pi + \delta_k}\right)}$$

Role of capital

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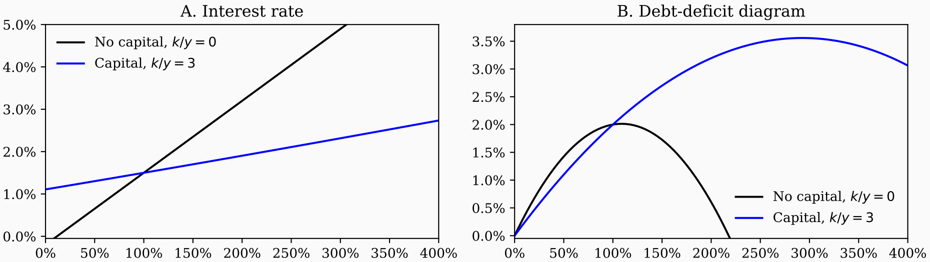
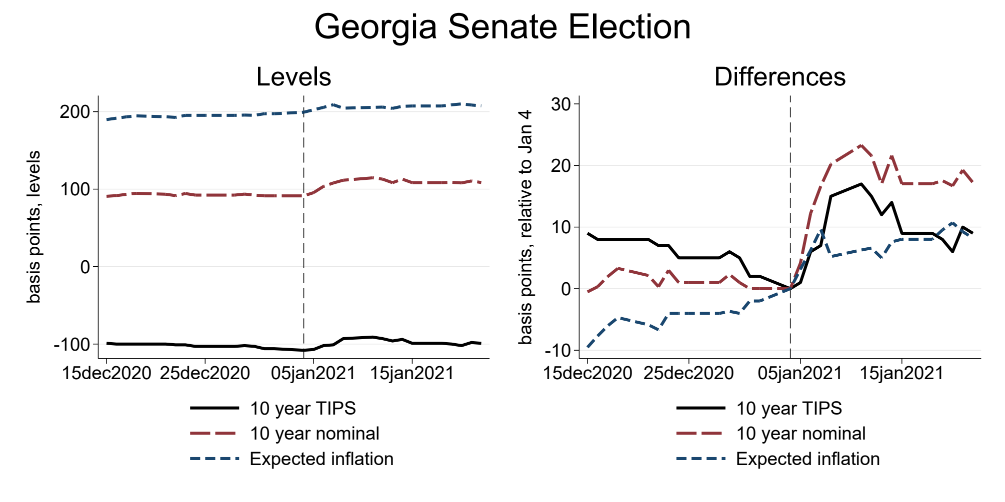


Estimating elasticity of convenience yield from Georgia run-offs

back



- TIPS moves Jan 5 to Jan 7 by about 7.5 basis points

Estimating elasticity of convenience yield from Georgia run-offs

back