Fiscal Multipliers

Liquidity Traps and Currency Unions

Emmanuel Farhi, Harvard
Iván Werning, MIT

Fiscal Stimulus?

Fiscal Stimulus?

- Monetary policy constraints...
  - ZLB liquidity trap
  - currency union

Fiscal Stimulus?

- Monetary policy constraints...
  - ZLB liquidity trap
  - currency union

Q. Fiscal Stimulus?

A. Yes!

Fiscal Stimulus?

- Monetary policy constraints...
  - ZLB liquidity trap
  - currency union

Q. Fiscal Stimulus?

A. Yes!

- Our goal: revisit
  - compare trap to unions (local vs. national multipliers)
  - inspect mechanism: closed forms

Our Paper

- Important other studies
- Distinguishing features...
  - closed forms
  - comprehensive treatment under one roof
    - open economy vs. liquidity trap
    - incomplete/complete markets
    - liquidity constraints
  - role of transfers

What We Do

- New Keynesian model
- Arbitrary government spending process
- Closed-form solution for fiscal multipliers
- Focus on liquidity traps and currency unions

What We Do

- New Keynesian model

- Arbitrary government spending process
- Closed-form solution for fiscal multipliers
- Focus on liquidity traps and currency unions

Today

Main Results

Main Results

- Liquidity traps (fixed interest rate)
  - large multipliers > 1
  - larger with...
    - price flexibility
    - backloading

Main Results

- Liquidity traps (fixed interest rate)
  - large multipliers > 1
  - larger with...
    - price flexibility
    - backloading
- Currency union (also, fixed interest rate but)...
  - small multipliers < 1
  - larger with...
    - price rigidity
    - outside transfers

Income Effects

- Price effects vs. Income effects?
  - Transfer multipliers: G paid by outside
  - Non-Ricardian effects from liquidity constrained agents

Liquidity Trap

Liquidity Trap

- Closed economy New Keynesian model
- Zero lower bound
- Continuous time
  - tractable
  - more insightful e.g. at t=0

Liquidity Trap Model

$$\int_0^\infty e^{-\rho t} \left[\frac{C_t^{1-\sigma}}{1-\sigma} + \chi \frac{G_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\phi}}{1+\phi} \right] dt,$$

$$\dot{D}_t = i_t D_t - P_t C_t + W_t N_t + \Pi_t + T_t$$

$$C_t = \left(\int_0^1 C_t(j)^{\frac{\epsilon-1}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}}$$

$$G_t = \left(\int_0^1 G_t(j)^{\frac{\epsilon-1}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}}$$

Liquidity Trap Model

$$\int_0^\infty e^{-\rho t}\left[\frac{C_t^{1-\sigma}}{1-\sigma}+\chi\frac{G_t^{1-\sigma}}{1-\sigma}-\frac{N_t^{1+\phi}}{1+\phi}\right]dt,$$

$$\dot{D}_t = i_t D_t - P_t C_t + W_t N_t + \Pi_t + T_t$$

$$C_t = \left(\int_0^1 C_t(j)^{\frac{\epsilon-1}{\epsilon}}dj\right)^{\frac{\epsilon}{\epsilon-1}}$$

$$G_t = \left(\int_0^1 G_t(j)^{\frac{\epsilon-1}{\epsilon}}dj\right)^{\frac{\epsilon}{\epsilon-1}}$$

$$Y_t(j) = A_t N_t(j)$$

+ Calvo pricing

Liquidity Trap Model

$$\int_0^\infty e^{-\rho t}\left[\frac{C_t^{1-\sigma}}{1-\sigma}+\chi\frac{G_t^{1-\sigma}}{1-\sigma}-\frac{N_t^{1+\phi}}{1+\phi}\right]dt,$$

$$Y_t(j) = A_t N_t(j)$$

$$\dot{D}_t = i_t D_t - P_t C_t + W_t N_t + \Pi_t + T_t$$

+ Calvo pricing

$$C_t = \left(\int_0^1 C_t(j)^{\frac{\epsilon-1}{\epsilon}} dj\right)^{\frac{\epsilon}{\epsilon-1}}$$

$$G_t = \left(\int_0^1 G_t(j)^{\frac{\epsilon-1}{\epsilon}} dj\right)^{\frac{\epsilon}{\epsilon-1}}$$

$$\dot{c}_t = \hat{\sigma}^{-1}\left(i_t - \pi_t - \bar{r}_t\right)$$

$$\dot{\pi}_t = \rho\pi_t - \kappa\left(c_t + (1-\xi)g_t\right)$$

Liquidity Trap Model

$$\int_0^\infty e^{-\rho t}\left[\frac{C_t^{1-\sigma}}{1-\sigma}+\chi\frac{G_t^{1-\sigma}}{1-\sigma}-\frac{N_t^{1+\phi}}{1+\phi}\right]dt,$$

$$\dot{D}_t = i_t D_t - P_t C_t + W_t N_t + \Pi_t + T_t$$

$$C_t = \left(\int_0^1 C_t(j)^{\frac{\epsilon-1}{\epsilon}}dj\right)^{\frac{\epsilon}{\epsilon-1}}$$

$$G_t = \left(\int_0^1 G_t(j)^{\frac{\epsilon-1}{\epsilon}}dj\right)^{\frac{\epsilon}{\epsilon-1}}$$

$$Y_t(j) = A_t N_t(j)$$

+ Calvo pricing

$$\dot{c}_t = \hat{\sigma}^{-1}\left(i_t - \pi_t - \bar{r}_t\right)$$

$$\dot{\pi}_t = \rho\pi_t - \kappa\left(c_t + (1-\xi)g_t\right)$$

$$\left(\text{where } \xi = \frac{\hat{\sigma}}{\hat{\sigma}+\phi}\right)$$

Defining Fiscal Multipliers

- Keeping $\{i_t\}$ fixed as we vary $\{g_t\}$

$$c_t = \tilde{c}_t + \int_0^\infty \alpha_s^c g_{t+s} ds$$

$$\pi_t = \tilde{\pi}_t + \int_0^\infty \alpha_s^\pi g_{t+s} ds$$

Defining Fiscal Multipliers

- Keeping $\{i_t\}$ fixed as we vary $\{g_t\}$

Multipliers

$$c_t = \tilde{c}_t + \int_0^\infty \alpha_s^c g_{t+s} ds$$

$$\pi_t = \tilde{\pi}_t + \int_0^\infty \alpha_s^\pi g_{t+s} ds$$

Defining Fiscal Multipliers

- Keeping $\{i_t\}$ fixed as we vary $\{g_t\}$

$$c_t = \tilde{c}_t + \int_0^\infty \alpha_s^c g_{t+s} ds$$

Multipliers

equilibrium with $g_t = 0$ for all t

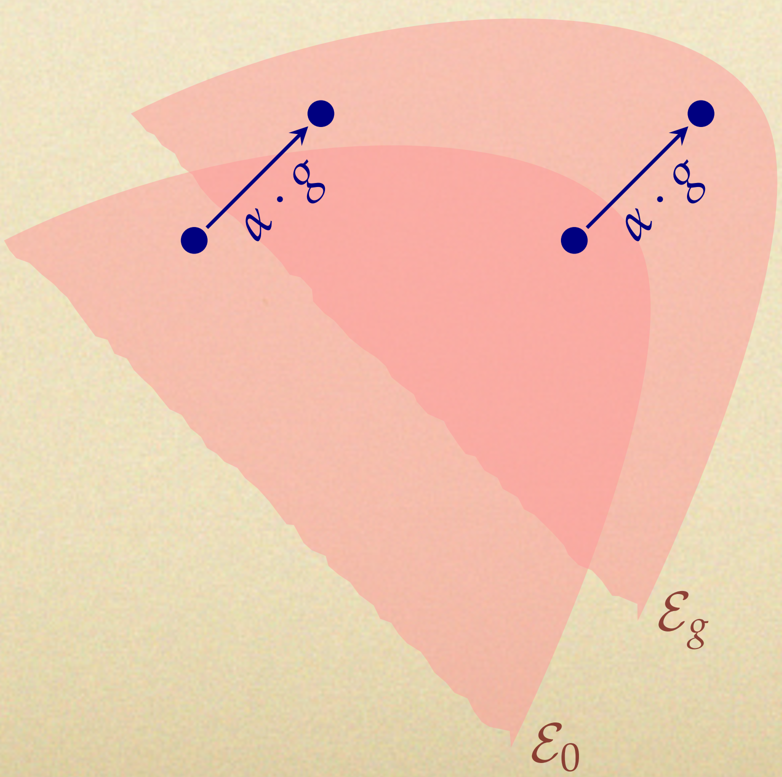
$$\pi_t = \tilde{\pi}_t + \int_0^\infty \alpha_s^\pi g_{t+s} ds$$

Defining Fiscal Multipliers

- Keeping $\{i_t\}$ fixed as we vary $\{g_t\}$

$$c_t = \tilde{c}_t + \int_0^\infty \alpha_s^c g_{t+s} ds$$

$$\pi_t = \tilde{\pi}_t + \int_0^\infty \alpha_s^\pi g_{t+s} ds$$



Fiscal Multipliers

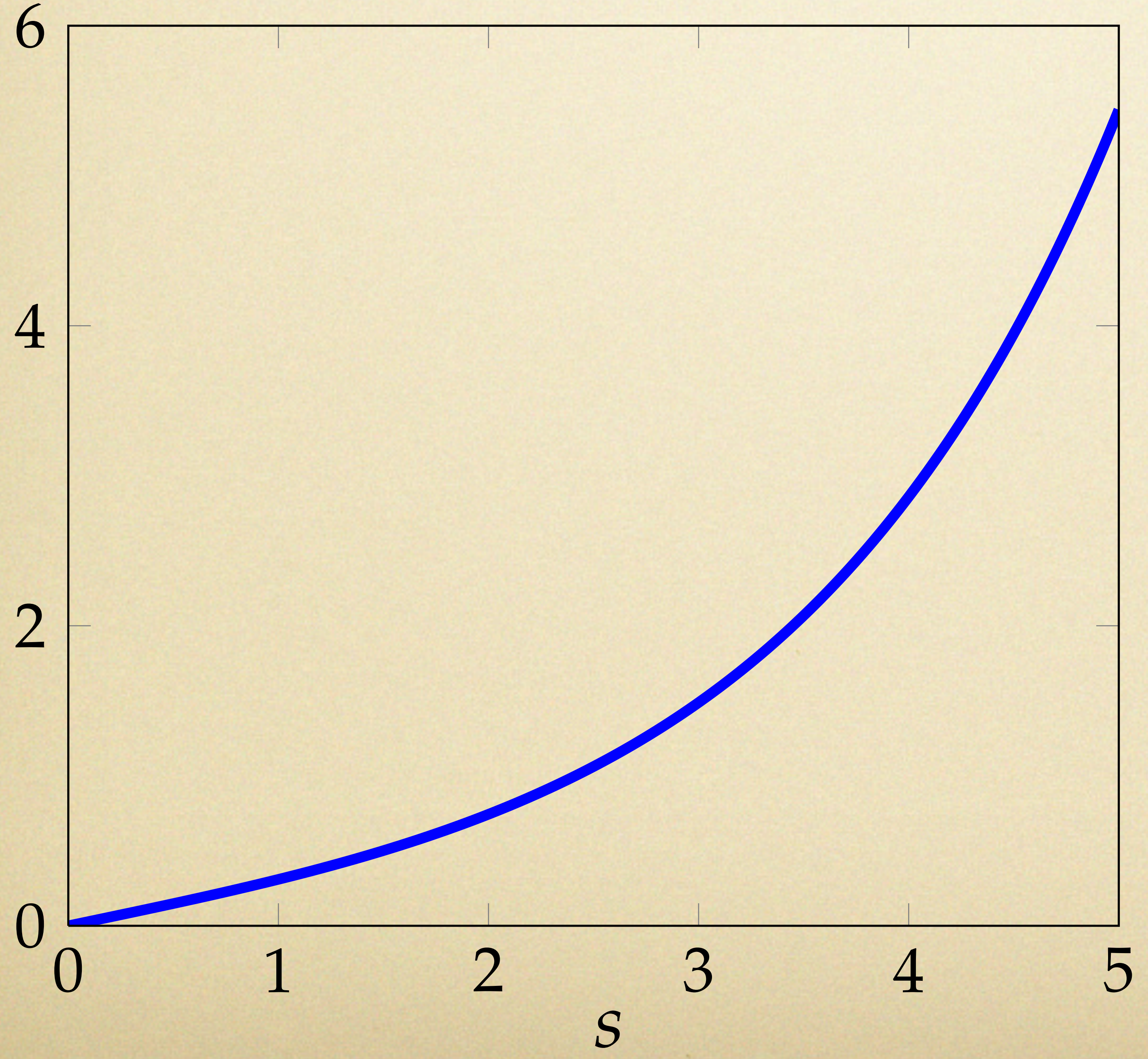
$$\nu = \frac{\rho - \sqrt{\rho^2 + 4\kappa\hat{\sigma}^{-1}}}{2} \qquad \bar{\nu} = \frac{\rho + \sqrt{\rho^2 + 4\kappa\hat{\sigma}^{-1}}}{2}$$

Proposition (Fiscal Multipliers).
Fiscal multipliers are given by

$$\alpha_s^c = \hat{\sigma}^{-1}\kappa(1-\xi)e^{-\bar{\nu}s}\frac{e^{(\bar{\nu}-\nu)s}-1}{\bar{\nu}-\nu}$$

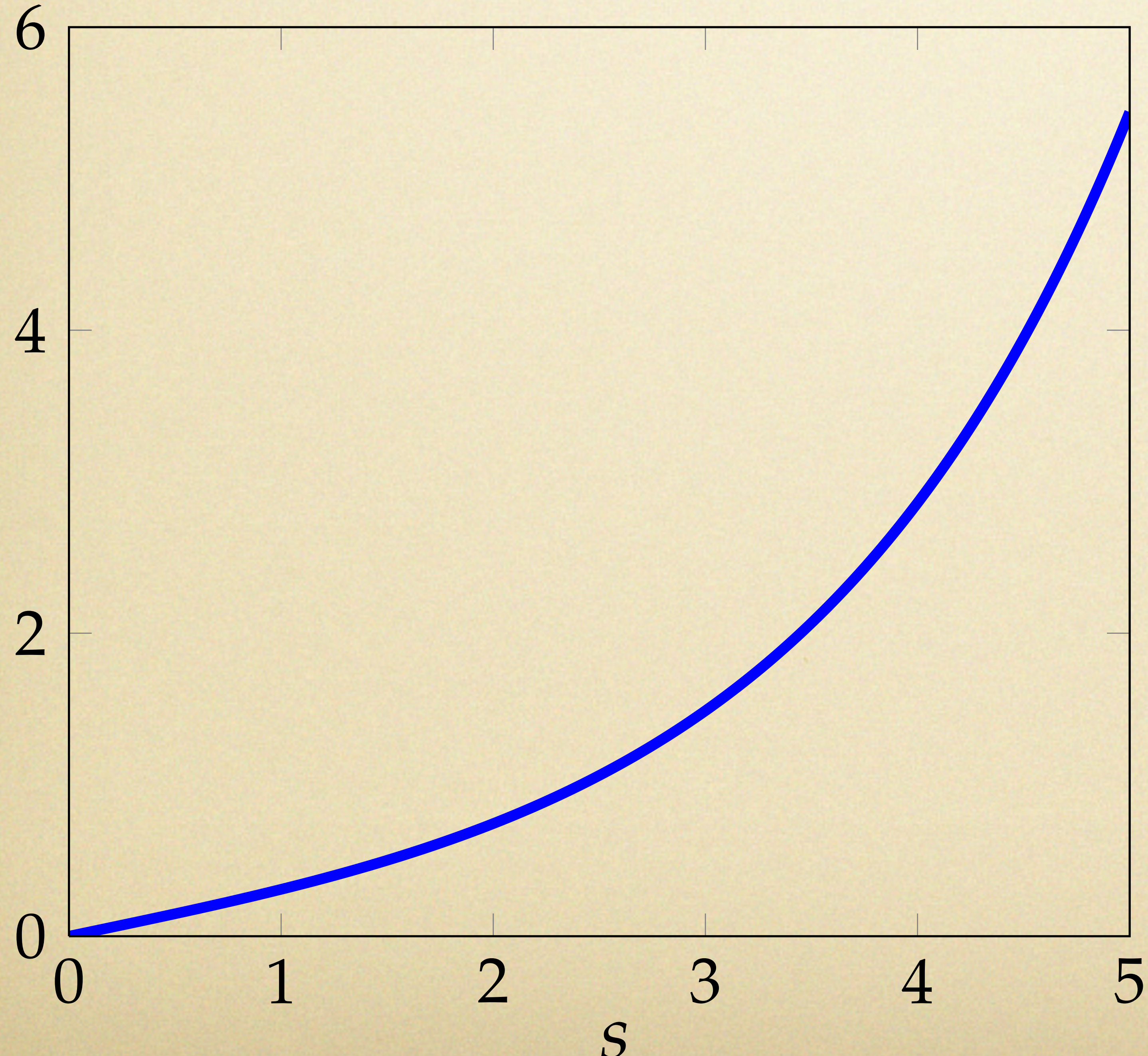
$$c_t = \tilde{c}_t + \int_0^\infty \alpha_s^c g_{t+s} ds$$

$$\alpha_s^c = \frac{\kappa}{\hat{\sigma}}(1-\xi)\frac{e^{-\nu s} - e^{-\bar{\nu} s}}{\bar{\nu} + |\nu|}$$



$$c_t = \tilde{c}_t + \int_0^\infty \alpha_s^c g_{t+s} ds$$

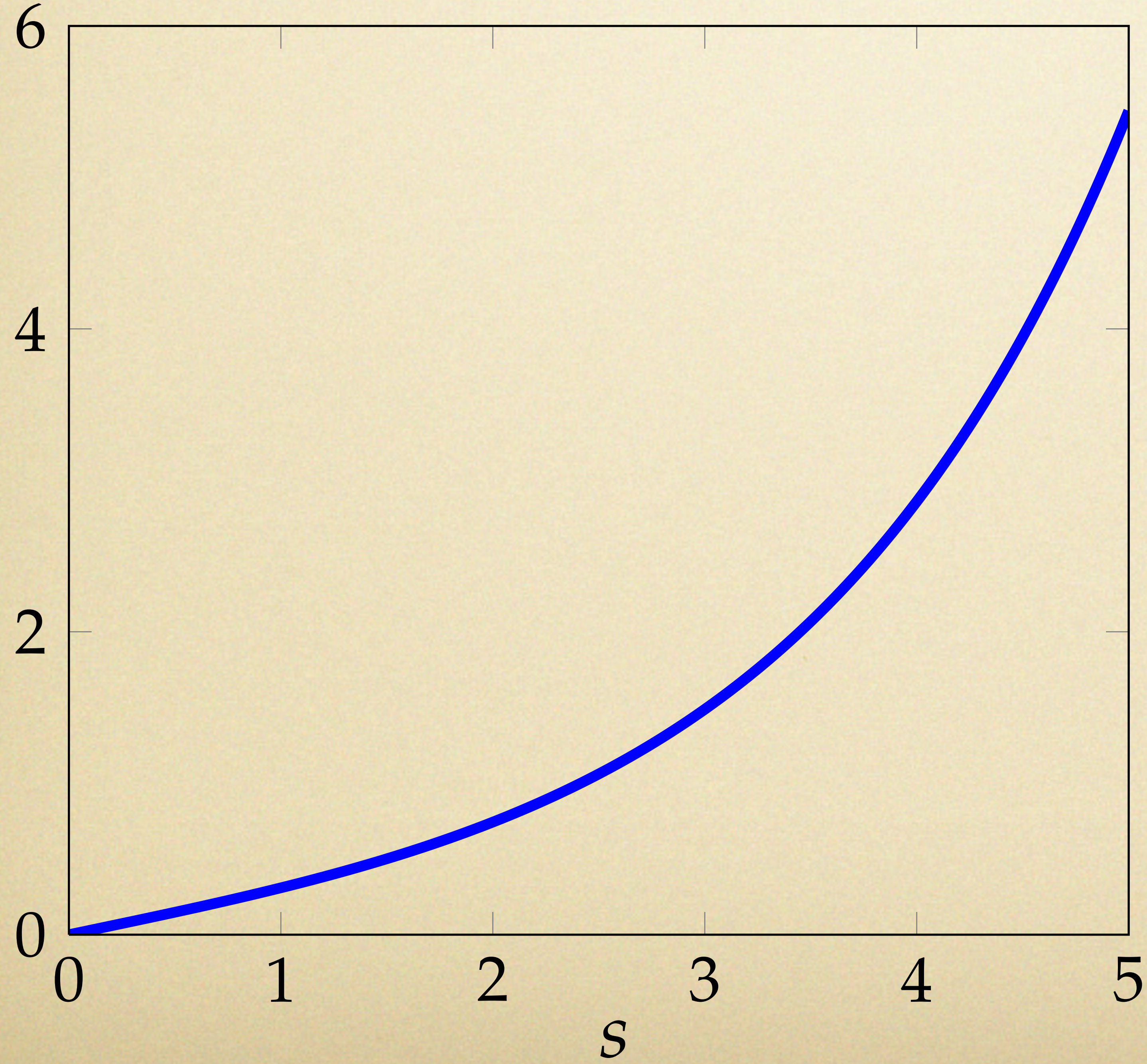
$$\alpha_s^c = \frac{\kappa}{\hat{\sigma}}(1-\xi)\frac{e^{-\nu s} - e^{-\bar{\nu} s}}{\bar{\nu} + |\nu|}$$



- Output Multiplier > 1

$$c_t = \tilde{c}_t + \int_0^\infty \alpha_s^c g_{t+s} ds$$

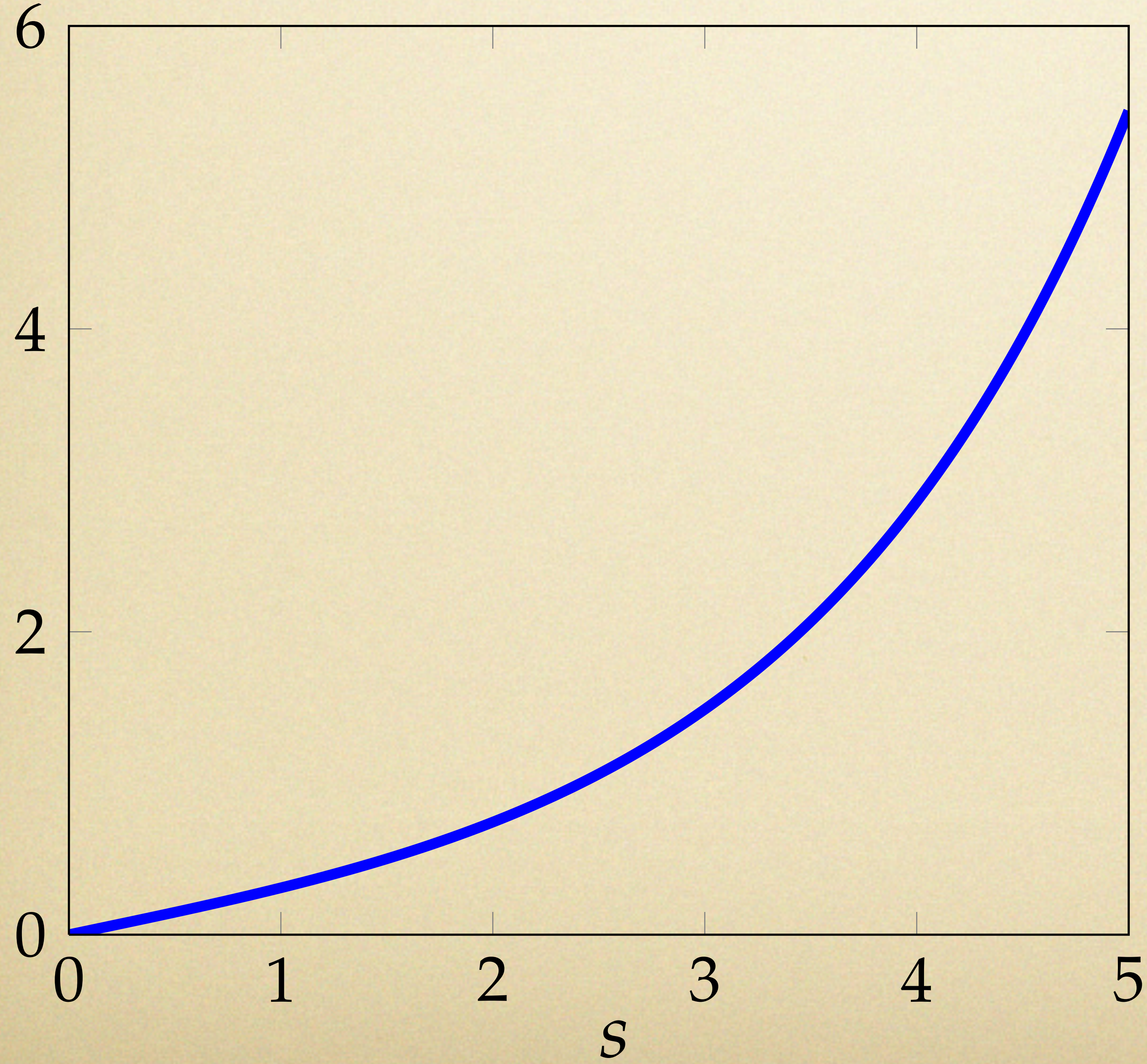
$$\alpha_s^c = \frac{\kappa}{\hat{\sigma}}(1-\xi)\frac{e^{-\nu s} - e^{-\bar{\nu} s}}{\bar{\nu} + |\nu|}$$



- Output Multiplier > 1
- Results

$$c_t = \tilde{c}_t + \int_0^\infty \alpha_s^c g_{t+s} ds$$

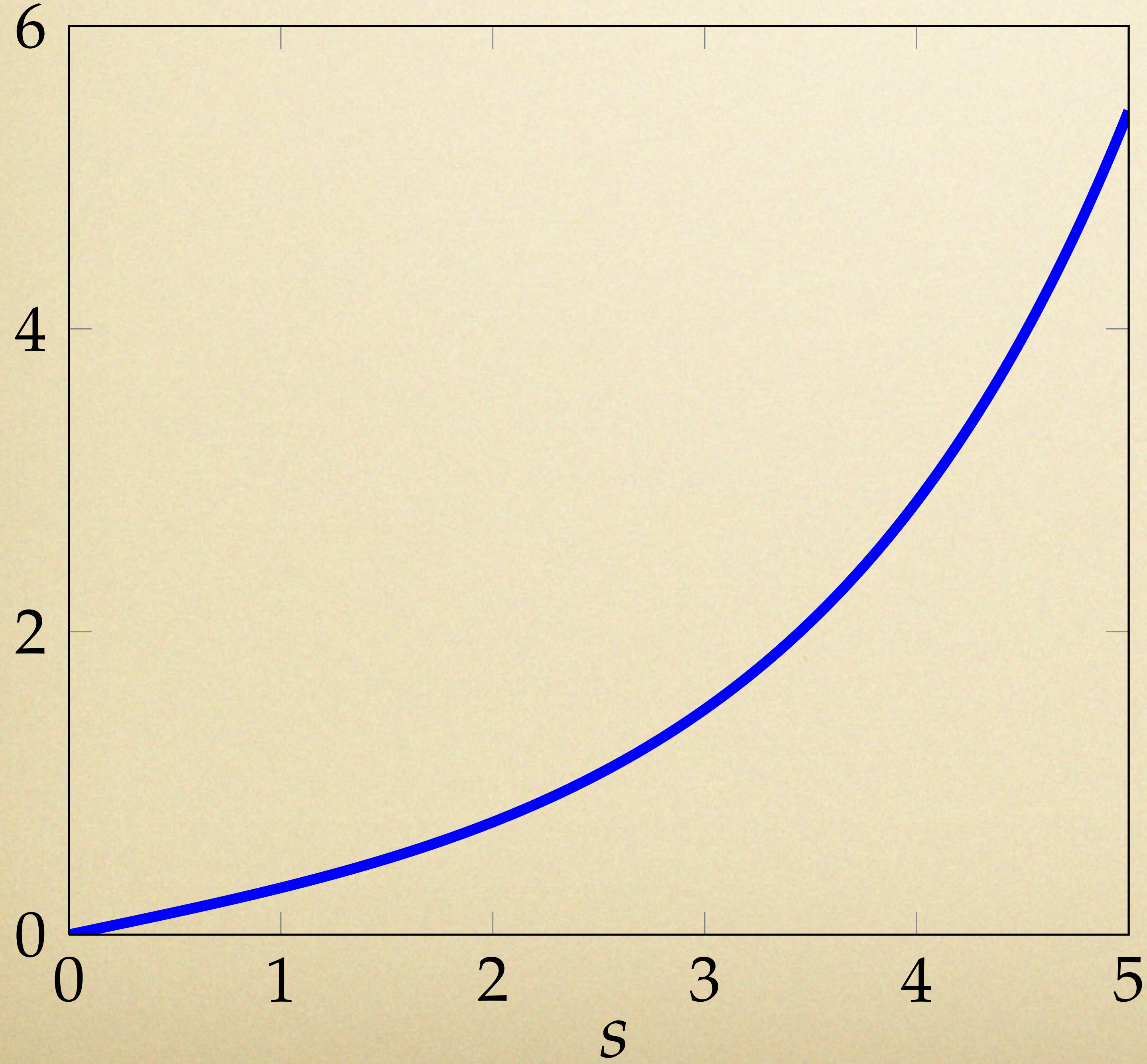
$$\alpha_s^c = \frac{\kappa}{\hat{\sigma}}(1-\xi)\frac{e^{-\nu s} - e^{-\bar{\nu} s}}{\bar{\nu} + |\nu|}$$



- Output Multiplier > 1
- Results
  - price flexibility

$$c_t = \tilde{c}_t + \int_0^\infty \alpha_s^c g_{t+s} ds$$

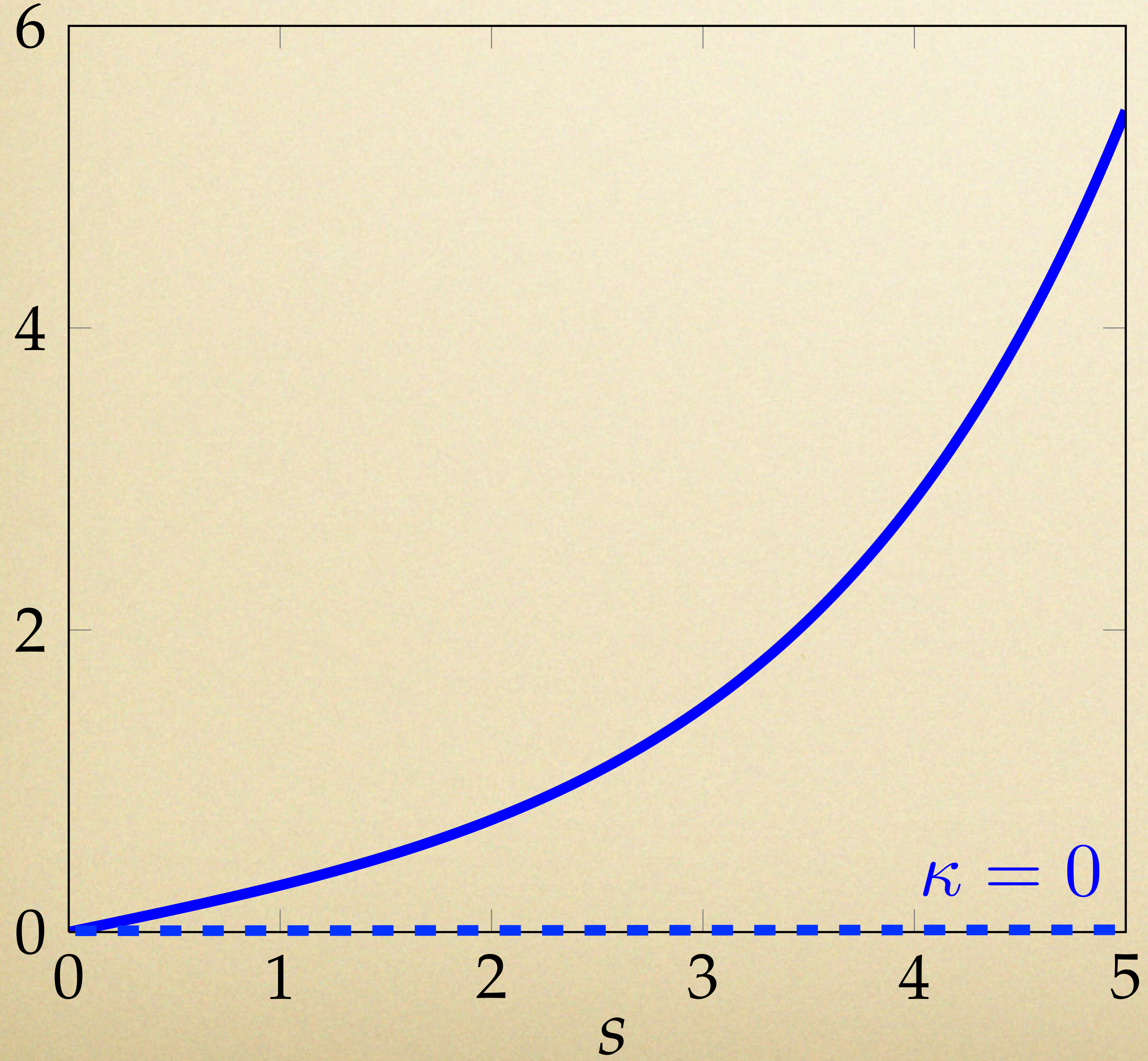
$$\alpha_s^c = \frac{\kappa}{\hat{\sigma}}(1-\xi)\frac{e^{-\nu s} - e^{-\bar{\nu} s}}{\bar{\nu} + |\nu|}$$



- Output Multiplier > 1
- Results
  - price flexibility
  - backloading

$$c_t = \tilde{c}_t + \int_0^\infty \alpha_s^c g_{t+s} ds$$

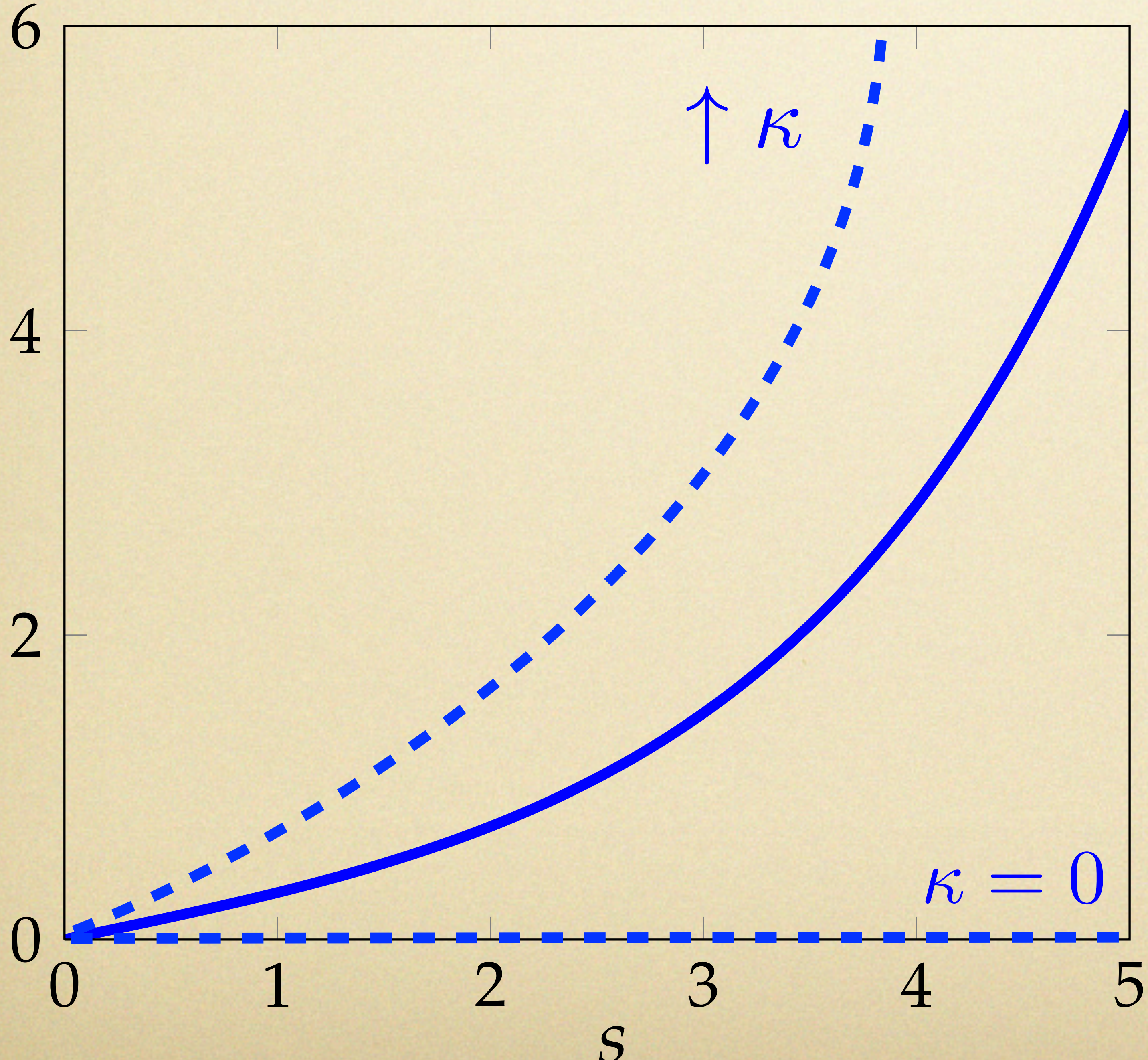
$$\alpha_s^c = \frac{\kappa}{\hat{\sigma}}(1-\xi)\frac{e^{-\nu s} - e^{-\bar{\nu} s}}{\bar{\nu} + |\nu|}$$



- Output Multiplier > 1
- Results
  - price flexibility
  - backloading

$$c_t = \tilde{c}_t + \int_0^\infty \alpha_s^c g_{t+s} ds$$

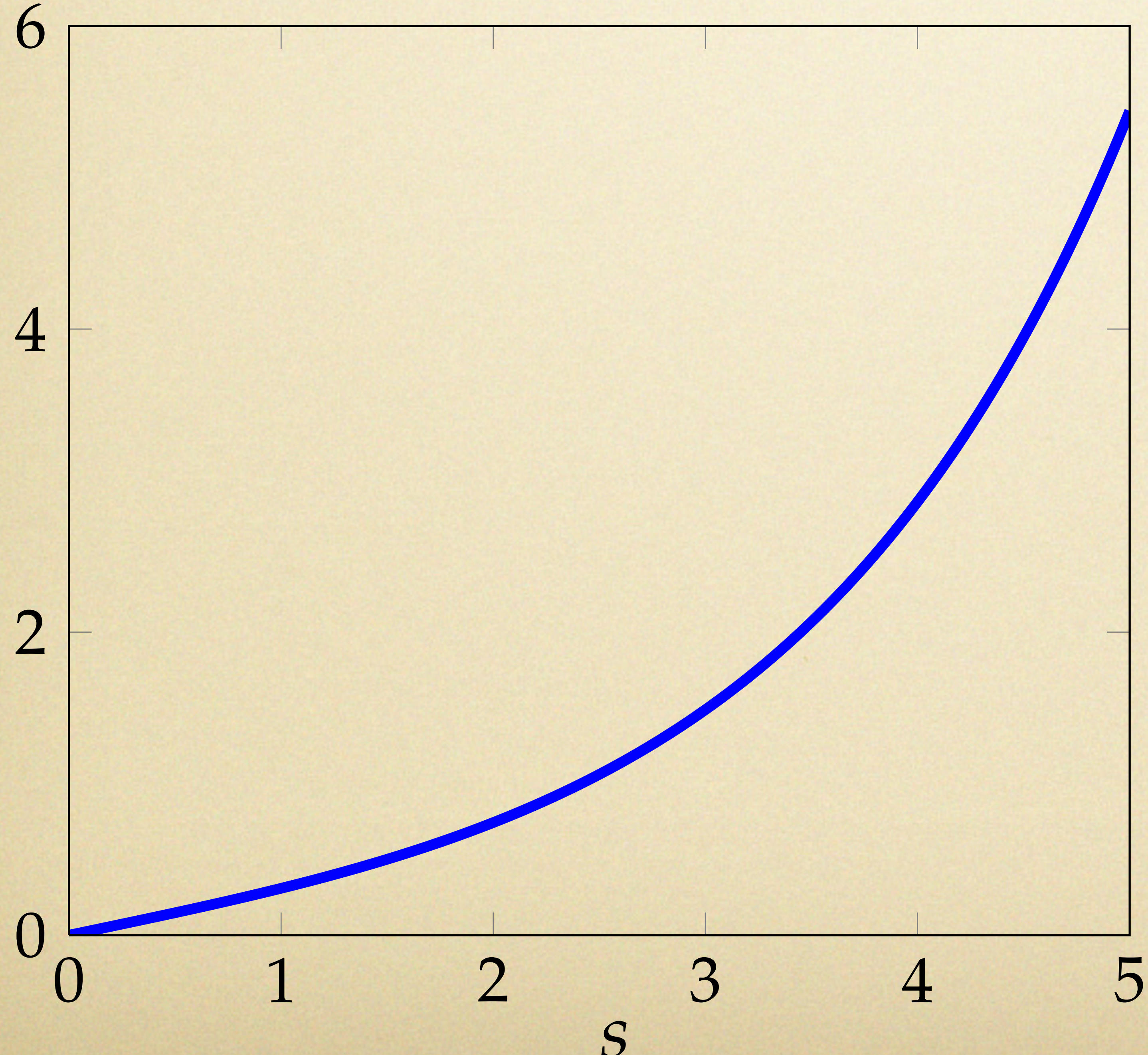
$$\alpha_s^c = \frac{\kappa}{\hat{\sigma}}(1-\xi)\frac{e^{-\nu s} - e^{-\bar{\nu} s}}{\bar{\nu} + |\nu|}$$



- Output Multiplier > 1
- Results
  - price flexibility
  - backloading

$$c_t = \tilde{c}_t + \int_0^\infty \alpha_s^c g_{t+s} ds$$

$$\alpha_s^c = \frac{\kappa}{\hat{\sigma}}(1 - \xi)\frac{e^{-\nu s} - e^{-\bar{\nu} s}}{\bar{\nu} + |\nu|}$$



- Output Multiplier > 1
- Results
  - price flexibility
  - backloading

Takeaway

- Multipliers large, but work through inflation
- Realistic?
  - well anchored inflation
  - very sticky prices
  - relies on substitution effect

- Income effects? Old Keynesian?
- Come back to this later...

Currency Union

Setup

- Similar to closed economy...
- Continuum of small open economies
- Goods differentiated by variety and country
- Home bias in consumption
- Financial markets:
  - complete markets
  - incomplete markets
- Government spending on domestic goods (for now)

Differentiated Goods

- Consumption aggregates

$$C_t = \left[(1-\alpha)^{\frac{1}{\eta}} C_{H,t}^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} C_{F,t}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}$$

$$C_{H,t} = \left(\int_0^1 C_{H,t}(j)^{\frac{\epsilon-1}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}}$$

$$C_{F,t} = \left(\int_0^1 C_{i,t}^{\frac{\gamma-1}{\gamma}} di \right)^{\frac{\gamma}{\gamma-1}}$$

$$C_{i,t} = \left(\int_0^1 C_{i,t}(j)^{\frac{\epsilon-1}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}}$$

(country i and variety j)

Differentiated Goods

- Price Indices

$$P_t = [(1-\alpha)P_{H,t}^{1-\eta} + \alpha P_{F,t}^{1-\eta}]^{\frac{1}{1-\eta}}$$

$$P_{H,t} = \left(\int_0^1 P_{H,t}(j)^{1-\epsilon} dj\right)^{\frac{1}{1-\epsilon}}$$

$$P_{F,t} = \left(\int_0^1 P_{i,t}^{1-\gamma} di\right)^{\frac{1}{1-\gamma}}$$

$$P_{i,t} = \left(\int_0^1 P_{i,t}(j)^{1-\epsilon} dj\right)^{\frac{1}{1-\epsilon}}$$

(country i and variety j)

Currency Union

- Small open economy
  - fixed exchange rate
  - differentiated goods by country
  - home bias or NT goods
  - financial markets
    - complete markets
    - incomplete markets

Currency Union

- Small open economy
  - fixed exchange rate
  - differentiated goods by country
  - home bias or NT goods
  - financial markets
    - complete markets ⟹ $c_t = -\hat{\sigma}^{-1} p_{H,t}$
    - incomplete markets

Currency Union

$$\dot{c}_t = -\hat{\sigma}^{-1}\pi_{H,t} \qquad \left(c_t = -\hat{\sigma}^{-1}p_{H,t}\right)$$

$$c_0 = 0$$

$$\dot{\pi}_{H,t} = \rho\pi_{H,t} - \kappa(c_t + (1-\xi)g_t)$$

$$\Rightarrow \quad c_t = \int_0^\infty \alpha_s^{c,t,CM} g_s ds$$

- Now...
  - past g_t affects current variables
  - terms of trade (cumulated inflation)

Defining Fiscal Multipliers

$$c_t = \int_{-t}^{\infty} \alpha_s^{c,t,CM} g_{t+s} ds$$

$$\pi_{H,t} = \int_{-t}^{\infty} \alpha_s^{\pi,t,CM} g_{t+s} ds$$

- Difference here...
  - past government spending
  - terms of trade (accumulated inflation)

Defining Fiscal Multipliers

$$c_t = \int_{-t}^{\infty} \alpha_s^{c,t,CM} g_{t+s} ds$$

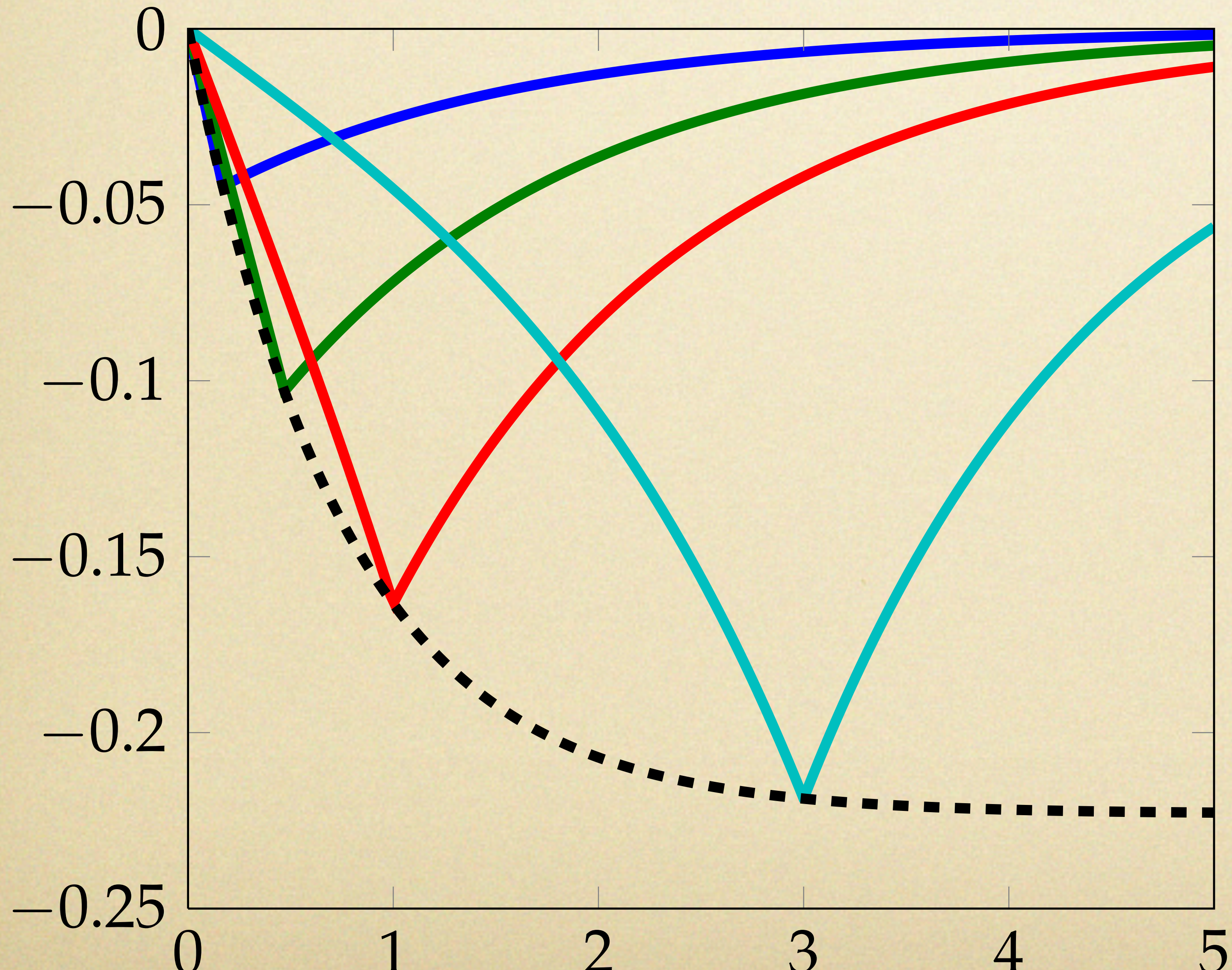
$$\pi_{H,t} = \int_{-t}^{\infty} \alpha_s^{\pi,t,CM} g_{t+s} ds$$

- Difference here...
  - past government spending
  - terms of trade (accumulated inflation)

$$c_t = \int_{-t}^{\infty} \alpha_s^{c,t,CM} g_{t+s} ds$$

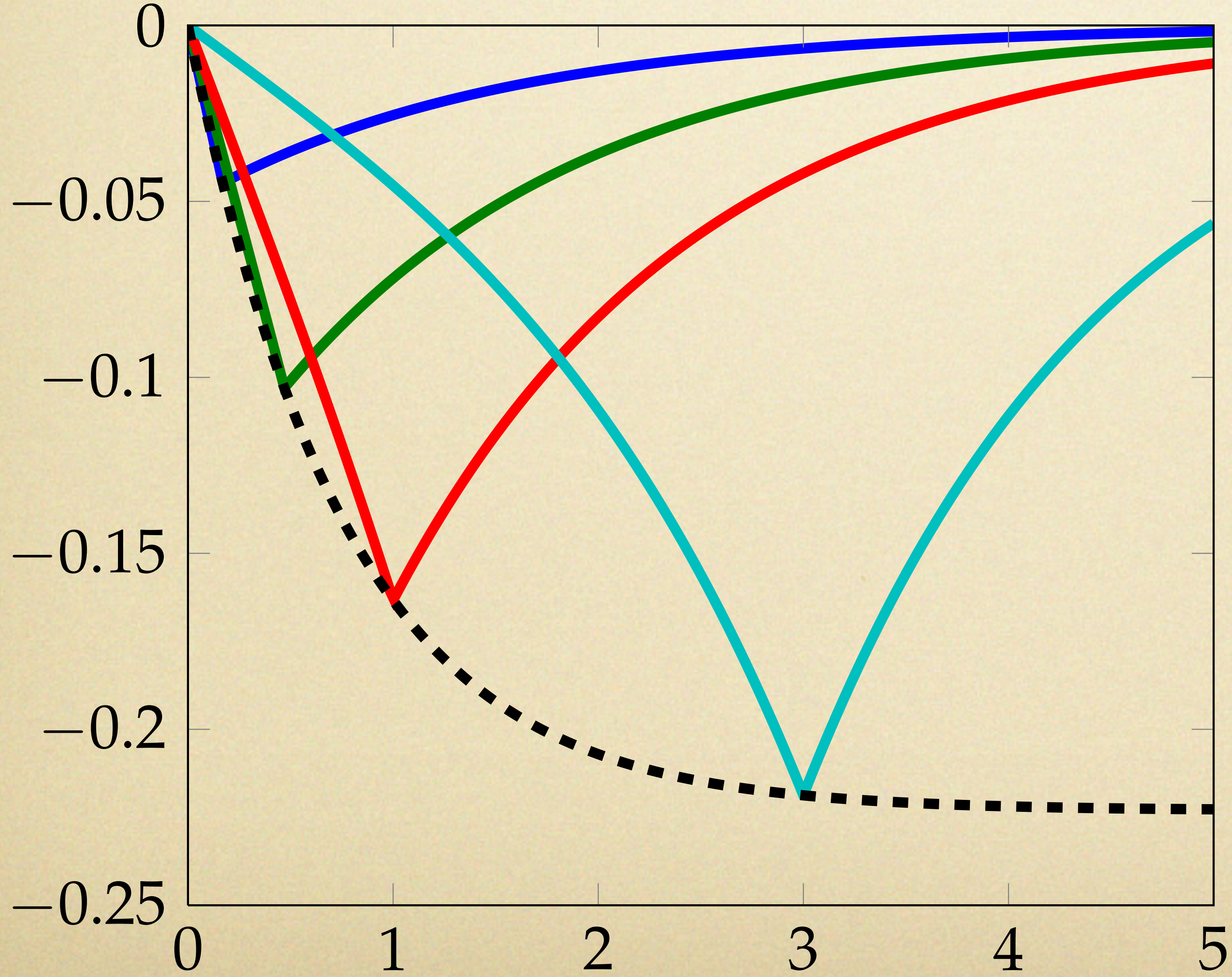
$$c_t = \int_{-t}^{\infty} \alpha_s^{c,t,CM} g_{t+s} ds$$

$$\alpha_s^{c,t,CM} = \begin{cases} -\hat{\sigma}^{-1}\kappa(1-\xi)e^{-\nu(s)}\frac{1-e^{(\nu-\bar{\nu})(s+t)}}{\bar{\nu}-\nu} & s < 0 \\ -\hat{\sigma}^{-1}\kappa(1-\xi)e^{-\bar{\nu}(s)}\frac{1-e^{-(\bar{\nu}-\nu)t}}{\bar{\nu}-\nu} & s \geq 0 \end{cases}$$



$$c_t = \int_{-t}^{\infty} \alpha_s^{c,t,CM} g_{t+s} ds$$

$$\alpha_s^{c,t,CM} = \begin{cases} -\hat{\sigma}^{-1}\kappa(1-\xi)e^{-\nu(s)} \frac{1-e^{(\nu-\bar{\nu})(s+t)}}{\bar{\nu}-\nu} & s < 0 \\ -\hat{\sigma}^{-1}\kappa(1-\xi)e^{-\bar{\nu}(s)} \frac{1-e^{-(\bar{\nu}-\nu)t}}{\bar{\nu}-\nu} & s \geq 0 \end{cases}$$



- Output Multiplier < 1
- Now...
  - past spending effect
  - competitiveness from cumulated inflation
  - frontloading

Liquidity Trap $\neq$ Currency Union

- Both fix interest rates
- Why difference?
  - liquidity trap = closed economy limit of open economy...
  - ...but implicit initial devaluation

$$e_0 = \int_0^\infty \kappa(1-\xi)e^{-\bar{\nu}s}\left(\frac{e^{(\bar{\nu}-\nu)s}-1}{\bar{\nu}-\nu}\right)g_s ds$$

Incomplete Markets

$$\alpha_s^{c,t,IM} = \alpha_s^{c,t,CM} + \delta_s^{c,t,IM}$$

- $\delta_s^{c,t,IM} = 0$ in CO case $\sigma = \eta = \gamma = 1$
- Away from CO case, $\delta_s^{c,t,IM}$
  - changes sign over time
  - depending on parameters:
    - first positive then negative...
    - ...or vice versa

Spending Paid by Foreign

- Transfer from Foreign $\mathrm{nfa}_0 = \int_0^\infty e^{-\rho t} g_t dt$

Proposition (Spending Paid by Foreign).
In the Cole-Obstfeld case

$$\alpha_s^{c,t,PF} = \alpha_s^{c,t,CM} + \delta_s^{c,t,PF}$$

$$\delta_s^{c,t,PF} = \left[e^{\nu t} \frac{1-\alpha}{\alpha} - (1 - e^{\nu t}) \frac{1}{1-\mathcal{G}} \frac{1}{\frac{1}{1-\mathcal{G}} + \phi} \right] \rho e^{-\rho(s+t)}$$

- Larger multiplier
- Local multiplier estimates

Transfer Multipliers

- Assume...
  - incomplete markets
  - transfer from outside

$$\hat{c}_t = \beta^{c,t}\mathrm{nfa}_0$$

$$\beta^{c,t} = e^{\nu t}\left(\rho\frac{1-\alpha}{\alpha}\right) + (1-e^{\nu t})\left(-\frac{\rho}{\frac{1}{1-\mathcal{G}}+\phi}\right)$$

Transfer Multipliers

- Assume...
  - incomplete markets
  - transfer from outside

$$\hat{c}_t = \beta^{c,t}\text{nfa}_0$$

$$\beta^{c,t} = e^{\nu t}\left(\rho\frac{1-\alpha}{\alpha}\right) + (1-e^{\nu t})\left(-\frac{\rho}{\frac{1}{1-\mathcal{G}}+\phi}\right)$$

Keynesian (+) Neoclassical (-)

Transfer Multipliers

- Assume...
  - incomplete markets
  - transfer from outside

$$\hat{c}_t = \beta^{c,t}\text{nfa}_0$$

$$\beta^{c,t} = e^{\nu t}\left(\rho\frac{1-\alpha}{\alpha}\right) + (1-e^{\nu t})\left(-\frac{\rho}{\frac{1}{1-\mathcal{G}}+\phi}\right)$$

Keynesian (+) Neoclassical (-)

- Spending paid by outsiders $\text{nfa}_0 = \int_0^\infty e^{-\rho t} g_t dt$
  - larger multiplier in shorter run
  - similar to capital inflow

Transfer Multipliers

- Limit as economy is closed
  - infinite transfer multiplier
- Limit as economy is fully open
  - zero transfer multiplier

- Wide range

Liquidity Constraints

- Follow Gali-LopezSalido-Valles (2007)
- Optimizers $1-\chi$ and hand-to-mouth χ
  - hand-to-mouth (HM) consume labor income minus lump-sum tax
  - allow differential taxation of optimizers and hand-to-mouth

Liquidity Constraints

$$c_t = \int_{-t}^{\infty} \alpha_s^{c,t,HM} g_{t+s} ds$$

Liquidity Constraints

$$c_t = \tilde{\Theta}_n g_t + \int_{-t}^{\infty} \alpha_s^{c,t,HM} g_{t+s} ds$$

Liquidity Constraints

$$c_t = \tilde{\Theta}_n g_t + \int_{-t}^{\infty} \alpha_s^{c,t,HM} g_{t+s} ds$$

$$\alpha_s^{c,t,HM} = \left(1 + \frac{\tilde{\Theta}_n}{1-\xi}\right) \tilde{\alpha}_s^{c,t}$$

$$\tilde{\alpha}_s^{c,t} = \begin{cases} -\tilde{\sigma}^{-1}\kappa(1-\xi)e^{-\tilde{\nu}s}\frac{1-e^{(\tilde{\nu}-\tilde{\tilde{\nu}})(s+t)}}{\tilde{\tilde{\nu}}-\tilde{\nu}} & s < 0 \\ -\tilde{\sigma}^{-1}\kappa(1-\xi)e^{-\tilde{\tilde{\nu}}s}\frac{1-e^{-(\tilde{\tilde{\nu}}-\tilde{\nu})t}}{\tilde{\tilde{\nu}}-\tilde{\nu}} & s \geq 0 \end{cases}$$

Liquidity Constraints

$$c_t = \tilde{\Theta}_n g_t \; - \tilde{\Theta}_\tau t_t^r \; + \int_{-t}^{\infty} \alpha_s^{c,t,HM} g_{t+s} ds$$

$$\alpha_s^{c,t,HM} = \left(1 + \frac{\tilde{\Theta}_n}{1-\xi}\right) \tilde{\alpha}_s^{c,t}$$

$$\tilde{\alpha}_s^{c,t} = \begin{cases} -\tilde{\sigma}^{-1}\kappa(1-\xi)e^{-\tilde{\nu}s}\frac{1-e^{(\tilde{\nu}-\tilde{\tilde{\nu}})(s+t)}}{\tilde{\tilde{\nu}}-\tilde{\nu}} & s < 0 \\ -\tilde{\sigma}^{-1}\kappa(1-\xi)e^{-\tilde{\tilde{\nu}}s}\frac{1-e^{-(\tilde{\tilde{\nu}}-\tilde{\nu})t}}{\tilde{\tilde{\nu}}-\tilde{\nu}} & s \geq 0 \end{cases}$$

Liquidity Constraints

$$c_t = \tilde{\Theta}_n g_t - \tilde{\Theta}_\tau t_t^r + \int_{-t}^{\infty} \alpha_s^{c,t,HM} g_{t+s} ds - \int_{-t}^{\infty} \gamma_s^{c,t,HM} t_{t+s}^r ds$$

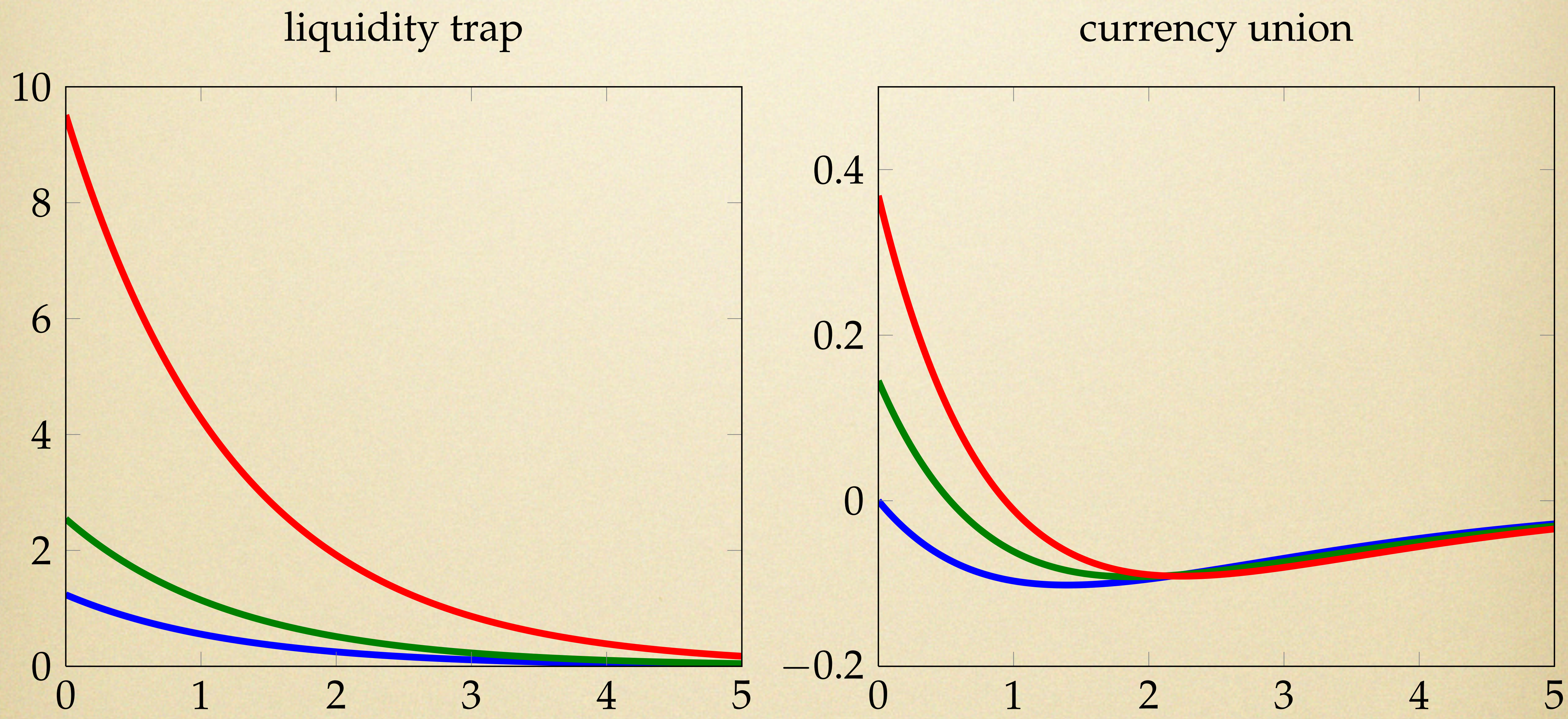
$$\alpha_s^{c,t,HM} = \left(1 + \frac{\tilde{\Theta}_n}{1-\xi}\right) \tilde{\alpha}_s^{c,t} \qquad \gamma_s^{c,t,HM} = \frac{\tilde{\tilde{\Theta}}_\tau}{1-\xi} \tilde{\alpha}_s^{c,t}$$

$$\tilde{\alpha}_s^{c,t} = \begin{cases} -\tilde{\sigma}^{-1}\kappa(1-\xi)e^{-\tilde{\nu}s}\frac{1-e^{(\tilde{\nu}-\tilde{\tilde{\nu}})(s+t)}}{\tilde{\tilde{\nu}}-\tilde{\nu}} & s < 0 \\ -\tilde{\sigma}^{-1}\kappa(1-\xi)e^{-\tilde{\tilde{\nu}}s}\frac{1-e^{-(\tilde{\tilde{\nu}}-\tilde{\nu})t}}{\tilde{\tilde{\nu}}-\tilde{\nu}} & s \geq 0 \end{cases}$$

Timing of Deficits

- Set taxes on optimizers and hand-to-mouth to be equal
- Deficits matter (not just spending)
- $t = 0$ effect of back-loading taxes on multipliers
    - increase (Keynesian)
    - decrease (New-Keynesian)

Liquidity Constraints



Takeaway

- Income vs. Substitution effects
  - hand to mouth agents: old Keynesian logic

- New Keynesian vs. Old Keynesian
- New Keynesian
  - bigger effect in liquidity trap
  - *smaller* in currency union
- Old Keynesian: increases in both

Liquidity Constraints

- Interaction
  - transfers from outsiders...
  - ...liquidity constrained consumers or governments

Transfer multiplier $\rho \frac{1-\alpha}{\alpha}$

Liquidity Constraints

- Interaction
  - transfers from outsiders...
  - ...liquidity constrained consumers or governments

Transfer multiplier $\uparrow \rho \frac{1-\alpha}{\alpha}$

Lessons

- Local multiplier estimates
- Europe?

Local Multipliers

- Evidence on multipliers, regressions using...
  - historical time series (Barro-Redlick)
  - cross country, event studies, ...
  - panel (Auerbach-Gorodichenko, Ramey-Zubairy)
- Problem
  - identification of exogenous shocks
  - small samples

Local Multipliers

- Local multiplier estimates
  - cross-regional, diff-in-diff
  - instrumental variables:
    - returns to retirement funds (Shoag)
    - military procurement (Nakamura-Steinsson)
    - mafia (Acconcia-Corsetti-Simonelli)
    - US stimulus (ARRA)
    - ....

Local Multipliers

$$Y_t = \alpha G_t + \varepsilon_t$$

Local Multipliers

- Pluses...
  - good identification
  - more data

$$Y_t = \alpha G_t + \varepsilon_t$$

Local Multipliers

- Pluses...
  - good identification
  - more data

$$Y_t = \alpha G_t + \varepsilon_t$$

Local Multipliers

- Pluses...
  - good identification
  - more data

$$Y_t = \alpha G_t + \varepsilon_t$$

- Minuses
  - omitted variable: transfers
  - high estimates misleading for self financed national policies?

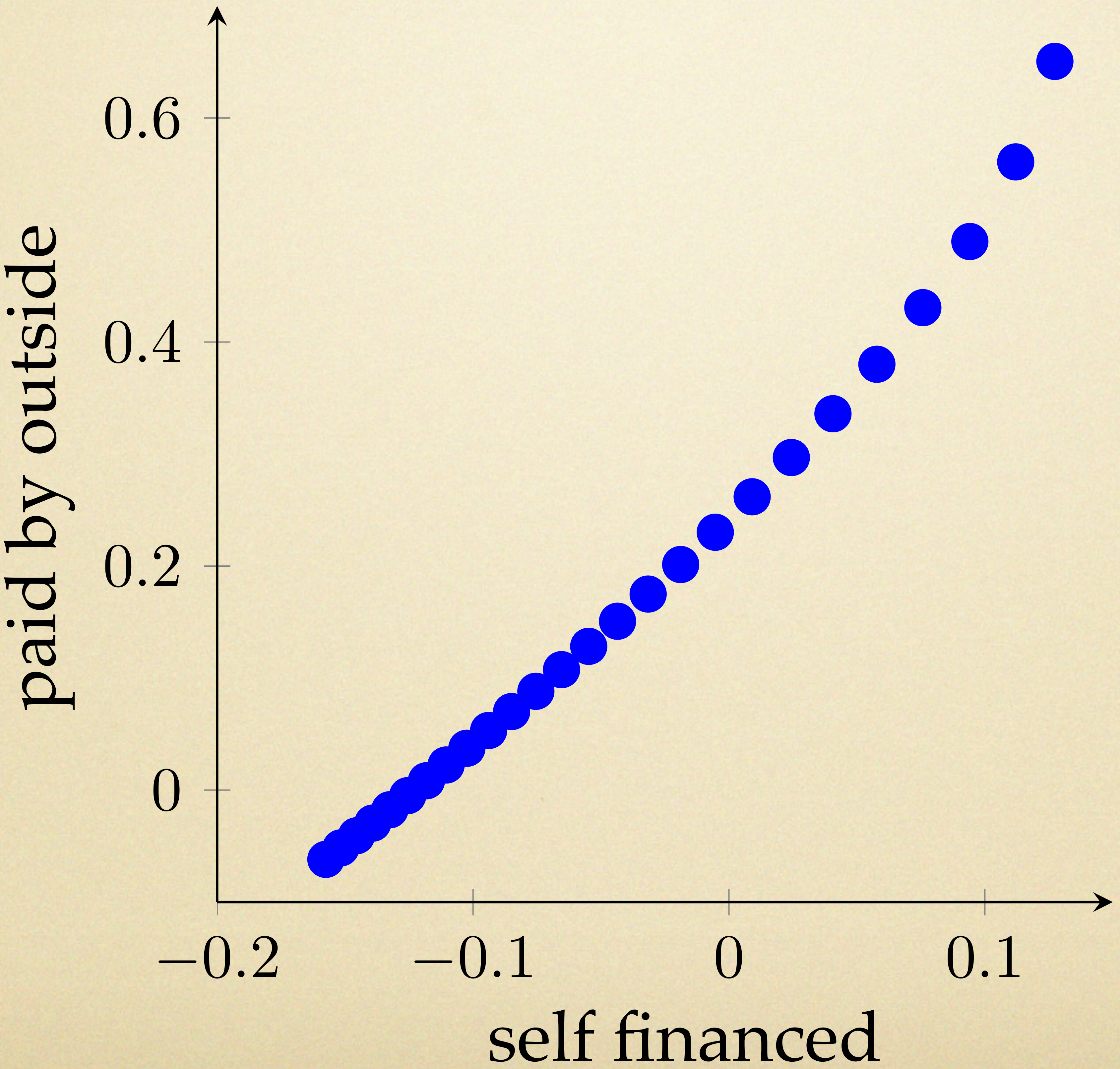
Local Multipliers

- Pluses...
  - good identification
  - more data

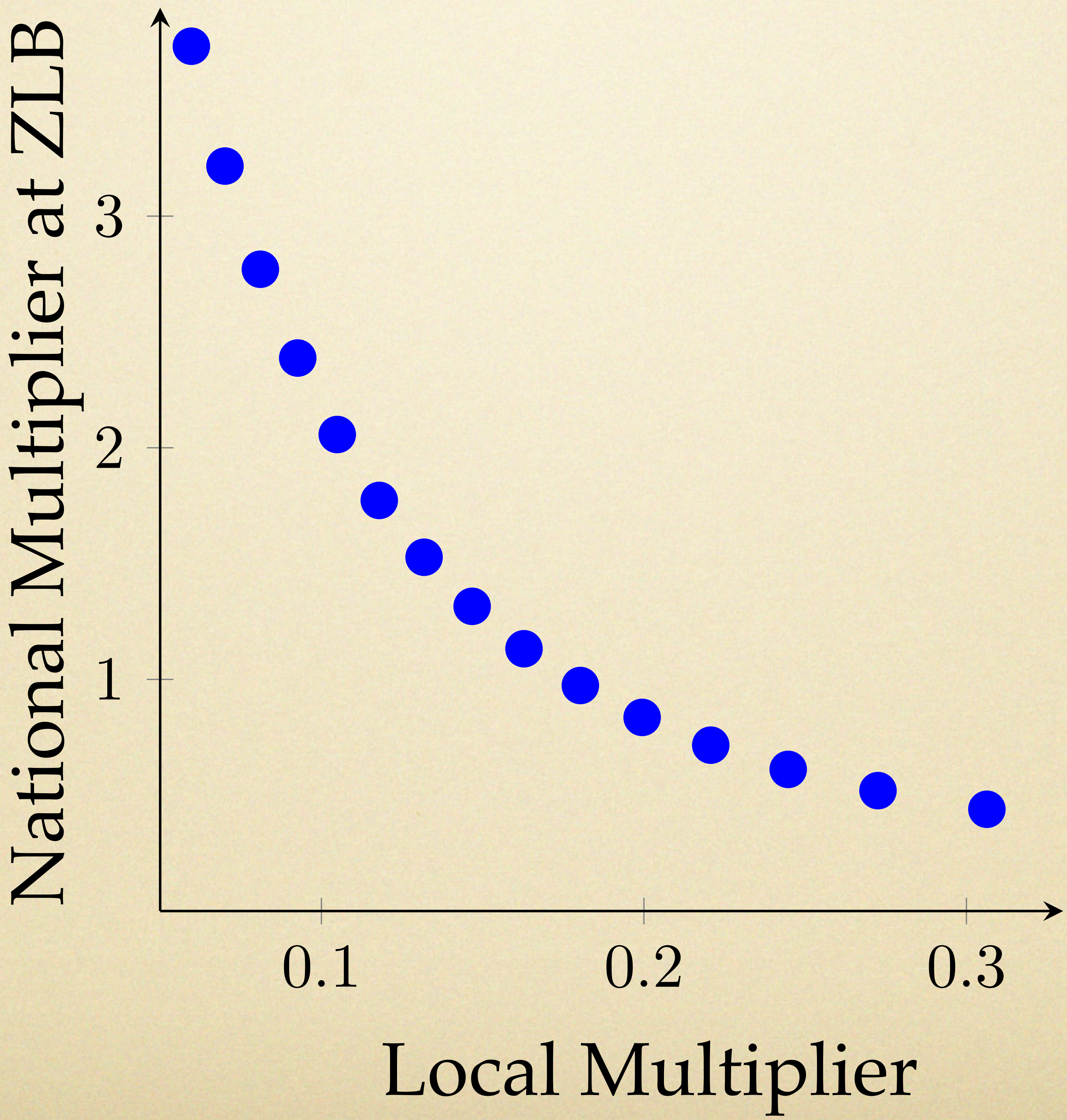
$$Y_t = \alpha G_t + \beta T_t + \varepsilon_t$$

- Minuses
  - omitted variable: transfers
  - high estimates misleading for self financed national policies?

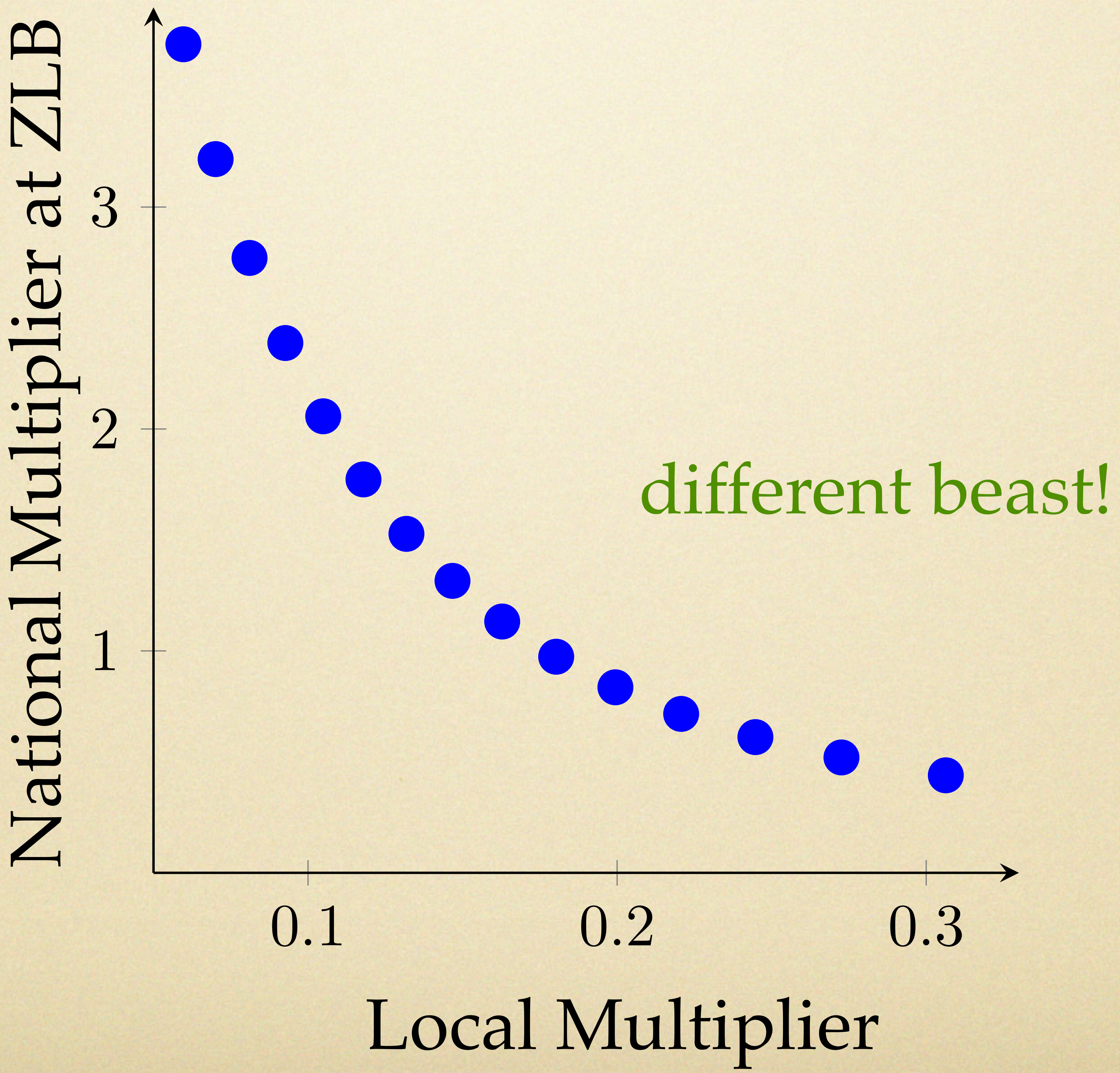
Liquidity Constraints



ZLB vs. Local Multipliers



ZLB vs. Local Multipliers



Europe

- Fiscal policy within EMU outside EMU
- Importance of transfers...
  - spending without transfers, effects smaller
  - transfers without government consumption?

- Last point: Fiscal Unions paper

Conclusions

- Price Effects vs. Income Effects
  - price effects
    - opposite in trap vs. union (backloading vs. frontloading)
    - low if prices are sticky
  - income effects
    - transfers from abroad: national vs. local
    - credit constraints: similar in trap and union → tighter link?

Appendix Slides

Country Size and Aggregation

- So far: small open economy
- Next: larger countries

- Interpret countries $i \in [0, x]$ as a single country
- Undertake same fiscal stimulus g_t^i
- Two monetary policies at union level...
  - perfectly targets inflation
  - passive (liquidity trap)

Inflation Targeting (Union)

Proposition (Large Countries, Inflation Targeting).
For Cole-Obstfeld preferences, if monetary policy targets union-wide inflation

$$c_t^i = -x(1-\xi)g_t^i + (1-x)\int_{-t}^{\infty} \alpha_s^{c,t,CM} g_{t+s}^i ds$$

$$c_t^{-i} = -(1-\xi)x g_t^i - x\int_{-t}^{\infty} \alpha_s^{c,t,CM} g_t^i ds$$

- Country size...weighted average
- Direct and indirect effects on other countries
- Germany and Europe in the 90's?

Liquidity Trap (Union)

Proposition (Large Countries, Inflation Targeting).
Cole-Obstfeld preferences and ZLB binding at union level

$$c_t^i = x \int_t^\infty \alpha_s^c g_{t+s}^i ds + (1-x) \int_{-t}^\infty \alpha_s^{c,t,CM} g_{t+s}^i ds$$

$$c_t^{-i} = x e^{\nu t} \int_0^\infty \alpha_s^c g_s^i ds$$

- Country size...weighted average
- Direct and indirect effects on other countries

Fiscal Multipliers

$$\nu = \frac{\rho - \sqrt{\rho^2 + 4\kappa\hat{\sigma}^{-1}}}{2} \qquad \bar{\nu} = \frac{\rho + \sqrt{\rho^2 + 4\kappa\hat{\sigma}^{-1}}}{2}$$

Proposition (Fiscal Multipliers).
Fiscal multipliers are given by

$$\alpha_s^c = \hat{\sigma}^{-1}\kappa(1-\xi)e^{-\bar{\nu}s}\frac{e^{(\bar{\nu}-\nu)s} - 1}{\bar{\nu}-\nu}$$

- Instantaneous fiscal multiplier is zero $\alpha_0^c = 0$
- Increasing and convex with horizon
- Grows unbounded $\lim_{s\to\infty} \alpha_s^c = \infty$

Fiscal Multipliers

Proposition (Fiscal Multipliers).
Fiscal multipliers are given by

$$\alpha_s^{c,t,CM} = \begin{cases} -\hat{\sigma}^{-1}\kappa(1-\xi)e^{-\nu s}\frac{1-e^{(\nu-\bar{\nu})(s+t)}}{\bar{\nu}-\nu} & s<0 \\ -\hat{\sigma}^{-1}\kappa(1-\xi)e^{-\bar{\nu} s}\frac{1-e^{-(\bar{\nu}-\nu)t}}{\bar{\nu}-\nu} & s\geq 0 \end{cases}$$

- Negative!
- As a function of horizon of spending:
  - V-shaped with peak for contemporaneous spending
  - zero for initial spending
  - zero for far in the future spending
- Size of negative peak increases with time
  - starts at zero
  - asymptotes to finite number