The Maturity Structure of Debt, Monetary Policy and Expectations Stabilization

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Motivation

- Fiscal conditions and monetary policy stabilization

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- Fiscal conditions and monetary policy stabilization

- ‘Standard’ view of monetary policy

  - Monetary authority alone determines inflation
  - Fiscal authority guarantees intertemporal solvency of the government
  - Expectations are ‘anchored’: consistent with policy objectives

Motivation

- Fiscal conditions and monetary policy stabilization

- Alternative views: 'Unpleasant arithmetic' and Fiscal theory of the price level
  - Outstanding nominal liabilities not fully backed up by future taxes
  - "Nominal anchor" shifts to fiscal policy

Motivation

- Fiscal conditions and monetary policy stabilization

- This presentation:

  - Incomplete knowledge about policy regime

  - Expectations inconsistent with policy objectives

  - Nonricardian effects regardless of the policy regime

What we do

- Simple NK model of output gap and inflation determination

- Departure from rational expectations:
  - Agents have an incomplete knowledge about the economy: learning
  - Implication: departures from Ricardian Equivalence

- Explore constraints imposed on monetary policy by choice of fiscal policy
  - Specifically: scale and composition of government debt

Results

- High level of debt...
- ...and short to medium maturity debt can lead to unanchored expectations
- Instability occurs if wealth effects from holding government debt are sufficiently strong

Model

Model Agents

- Households
- Firms
- Monetary authority
- Fiscal authority

Maturity of Public Debt

- Issues two kinds of debt
  - B_t^s: One period debt in zero net supply with price $P_t^s = (1 + i_t)^{-1}$

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- Issues two kinds of debt
  - B_t^s: One period debt in zero net supply with price $P_t^s = (1 + i_t)^{-1}$
  - B_t^m: An asset in positive supply that has declining payoff structure

$$\rho^{T-(t+1)} \text{ for } T \geq t+1$$

- P_t^m denotes the price of this second asset.

- Duration of the debt is $(1 - \beta\rho)^{-1}$; β discount rate

Monetary and Fiscal Authorities

- Flow budget constraint

$$P_t^m B_t^m = B_{t-1}^m (1 + \rho P_t^m) - P_t S_t$$

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$$P_t^m B_t^m = B_{t-1}^m (1 + \rho P_t^m) - P_t S_t$$

- Fiscal policy maintains intertemporal solvency ('Passive')

$$\tau_t^i = \bar{\tau}^i \left(\frac{B_{t-1}^m}{\bar{B}^m} \right)^{\tau_l^i} ; \tau_l^i > \tau_l^{*,i}$$

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$$\frac{1+i_t}{1+\bar{\imath}} = \left(\frac{\pi_t}{\pi^*}\right)^{\phi_\pi} ; \quad \phi_\pi > 1$$

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- Under rational expectations: standard view of monetary policy

Household Problem

- Saving and work decision. No capital in the model, only gov. bonds.

- Households' preferences

$$U(C_t, H_t) = (1-\sigma)^{-1} \left(C_t - \frac{\psi}{1+\gamma} C_t^{\iota} H_t^{1+\gamma} \right)^{1-\sigma}, \gamma > 0$$

  where

  - $\iota = 0 \rightarrow GHH$; $\iota = 1 \rightarrow KPR$ preferences

  - $\sigma \geq 1 \rightarrow IES \leq 1$, C_t, H_t complements

Key Equation 1: Consumption Decision

- Combining Euler eqs., labor supply, budget constraint to log-linear approx. provides

$$\hat{C}_t^{(i)} - (1 - \sigma^{-\iota})\Theta \hat{H}_t^{(i)} = \bar{s}_C^{-1}(\sigma, \iota)\left(\frac{\bar{S}}{\bar{Y}}\right) \times$$

$$\times \underbrace{\left(\hat{b}_{t-1}^{m,(i)} - \hat{\pi}_t + \rho\beta \hat{P}_t^m - \hat{E}_t^{(i)} \sum_{T=t}^{\infty} \beta^{T-t} \left[T(\hat{\tau}_T^{LS}, \hat{\tau}_T^W) - \beta\left(\hat{\imath}_T - \hat{\pi}_{T+1}\right)\right]\right)}_{\textit{Gov. Debt and Taxes}}$$

$$+\bar{s}_C^{-1}(\sigma, \iota)\,(1-\beta)\,\hat{E}_t^{(i)} \sum_{T=t}^{\infty} \beta^{T-t} x\left(\hat{w}_T, \hat{\Gamma}_T\right) - \beta\sigma^{-1} \hat{E}_t^{(i)} \sum_{T=t}^{\infty} \beta^{T-t}\left(\hat{\imath}_T - \hat{\pi}_{T+1}\right)$$

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$$+\bar{s}_C^{-1}(\sigma, \iota)(1 - \beta)\hat{E}_t^{(i)} \sum_{T=t}^{\infty} \beta^{T-t} x\left(\hat{w}_T, \hat{\Gamma}_T\right) - \beta\sigma^{-1}\hat{E}_t^{(i)} \sum_{T=t}^{\infty} \beta^{T-t}\left(\hat{\imath}_T - \hat{\pi}_{T+1}\right)$$

Key Equation 2: Public Debt

- Price of government debt

$$\hat{P}_t^m = \underbrace{-\hat{E}_t \sum_{T=t}^{\infty} (\rho\beta)^{T-t} \hat{\imath}_T}_{\text{Expectation Hypothesis}}$$

- Evolution of public Debt

$$\hat{b}_t^m = \beta^{-1} \left(\hat{b}_{t-1}^m - \hat{\pi}_t\right) + (1-\rho)\,\hat{\imath}_t - \left(\beta^{-1} - 1\right) \hat{s}_t$$

$$+ (1-\rho)\,\rho\beta \hat{E}_t \sum_{T=t}^{\infty} (\rho\beta)^{T-t} \hat{\imath}_{T+1}$$

Firms

- Monopolistic competition + nominal rigidities (Rotemberg)

- In aggregate, the Phillips curve

$$
\begin{aligned}
\hat{\pi}_t &= \psi\left(\gamma + \frac{\bar{Y}}{\bar{C}}\iota\right)\hat{Y}_t + \\
&\quad + \hat{E}_t \sum_{T=t}^{\infty} (\alpha\beta)^{T-t}\left[\psi\alpha\beta\hat{w}_{T+1} + (1-\alpha)\beta\hat{\pi}_{T+1}\right]
\end{aligned}
$$

Knowledge and learning

- Agents know only their own preferences and constraints
  - Simple model: agents are in fact identical but not aware of it
- Observe aggregate variables and disturbances
- Do not know true economic model determining variables outside their control
  - Forecasts using an econometric model
  - Model of anticipated utility: optimization ignores future model revisions

Learning and Expectations

- Inflation as an example. Rational Expectations (RE)

$$\hat{E}_t^{RE}\pi_{T+1} = 0 + \Omega_b^{RE}\hat{b}_{t-1}^m, \text{ where } T > t$$

- Learning

$$\hat{E}_t\pi_{T+1} = \Omega_{c,t-1}^L + \Omega_{b,t-1}^L\hat{b}_{t-1}^m + \text{lagged variables},$$

  - Coefficients updated every period (Recursive Least Squares)

- Convergence to RE? E-stability

  - Use methods of Marcet and Sargent (1989), Evans and Honkapohja (2001)

E-stability

- Numerical study: LUMP SUM taxation

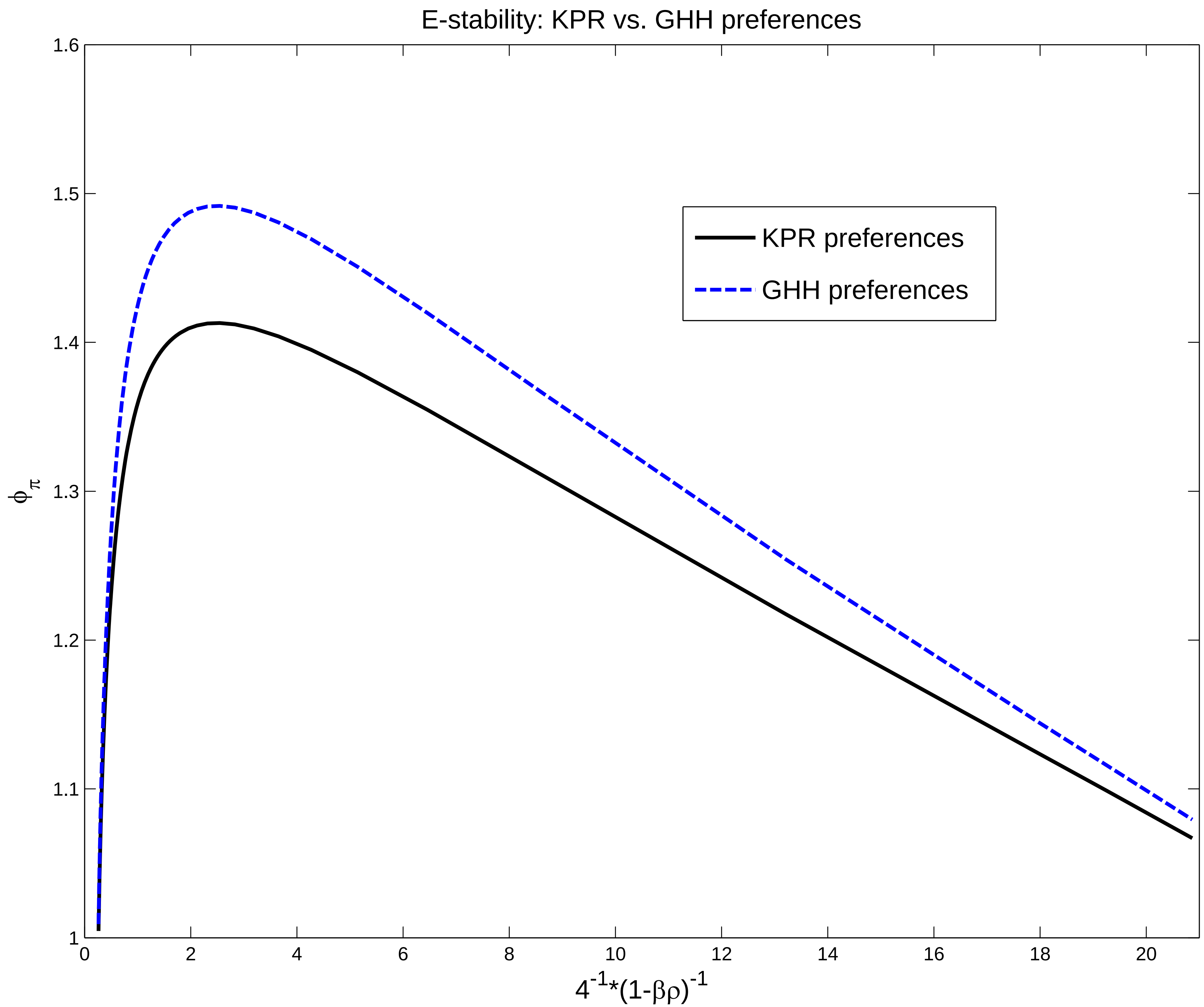
- Key parameters: $\sigma^{-1} = 1/4$,and $\frac{\bar{P}^m \bar{B}^m}{4\bar{P}\bar{Y}} = 1.5$

- Others:

  - Preferences and technology: $\beta = 0.99,\ \alpha = 0.8$ (Price stickiness)

  - Fiscal Policy: $\tau_l^{LS} = 1.5$

  - Steady State: $\bar{C}/\bar{Y} = 0.78$:



E-stability: KPR vs. GHH preferences
KPR preferences
GHH preferences
1.6
1.5
1.4
1.3
1.2
1.1
1
0
2
4
6
8
10
12
14
16
18
20
ϕ_π
$4^{-1}*(1-\beta\rho)^{-1}$

INTUITION

Agg. Demand: Increase in Inflation Expectations

- Ricardian Households

$$\hat{C}_t - (1 - \sigma^{-\iota})\Theta \hat{H}_t =$$

$$-\beta \sigma^{-1} \hat{E}_t^i \sum_{T=t}^{\infty} \beta^{T-t} \left(\phi_\pi \hat{\pi}_T - \hat{\pi}_{T+1}\right) +$$

$$+\bar{s}_C^{-1}(\sigma, \iota) \hat{E}_t^i \sum_{T=t}^{\infty} \beta^{T-t} x_T$$

  – we have substituted for the bond price equation and the monetary policy rule, $\hat{\imath}_t = \phi_\pi \hat{\pi}_t$

Agg. Demand: Increase in Inflation Expectations

- Baseline

$$
\hat{C}_t - (1 - \sigma^{-\iota})\Theta \hat{H}_t =
$$

$$
-\beta \left(\sigma^{-1} - \bar{s}_C^{-1}(\sigma, \iota) \frac{\bar{S}}{\bar{Y}} \right) \hat{E}_t^i \sum_{T=t}^{\infty} \beta^{T-t} \left(\phi_\pi \hat{\pi}_T - \hat{\pi}_{T+1} \right) +
$$

$$
-\bar{s}_C^{-1}(\sigma, \iota) \frac{\bar{S}}{\bar{Y}} \cdot \beta \rho \hat{E}_t \sum_{T=t}^{\infty} (\beta \rho)^{T-t} \left(\phi_\pi \hat{\pi}_T \right) +
$$

$$
+\bar{s}_C^{-1}(\sigma, \iota) \frac{\bar{S}}{\bar{Y}} \hat{b}_{t-1}^m + \bar{s}_C^{-1}(\sigma, \iota) (1 - \beta) \hat{E}_t^i \sum_{T=t}^{\infty} \beta^{T-t} \left[x_T - T_T \right].
$$

Agg. Demand: Increase in Inflation Expectations

- Baseline

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$$-\bar{s}_C^{-1}(\sigma,\iota)\frac{\bar{S}}{\bar{Y}}\cdot\beta\rho\hat{E}_t\sum_{T=t}^{\infty}(\beta\rho)^{T-t}\left(\phi_\pi\hat{\pi}_T\right) +$$

$$+\bar{s}_C^{-1}(\sigma,\iota)\frac{\bar{S}}{\bar{Y}}\hat{b}_{t-1}^m + \bar{s}_C^{-1}(\sigma,\iota)\left(1-\beta\right)\hat{E}_t^i\sum_{T=t}^{\infty}\beta^{T-t}\left[x_T - T_T\right].$$

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$$+\bar{s}_C^{-1}(\sigma, \iota) \frac{\bar{S}}{\bar{Y}} \hat{b}_{t-1}^m + \bar{s}_C^{-1}(\sigma, \iota) \left(1 - \beta \right) \hat{E}_t^i \sum_{T=t}^{\infty} \beta^{T-t} \left[x_T - T_T \right].$$

Gov. Debt: Increase in Inflation Expectations

- Using the bond price equation and the monetary policy rule, $\hat{\imath}_t = \phi_\pi \hat{\pi}_t$, permits the evolution of real debt to be written as

$$\begin{aligned} \hat{b}_t^m &= \beta^{-1}\left(\hat{b}_{t-1}^m - \hat{\pi}_t\right) + (1-\rho)\,\phi_\pi \hat{\pi}_t - \left(\beta^{-1} - 1\right)\hat{s}_t \\ &\quad + (1-\rho)\,\rho\beta \hat{E}_t \sum_{T=t}^{\infty} (\rho\beta)^{T-t}\,\phi_\pi \hat{\pi}_{T+1} \end{aligned}$$

  which depends on the maturity structure

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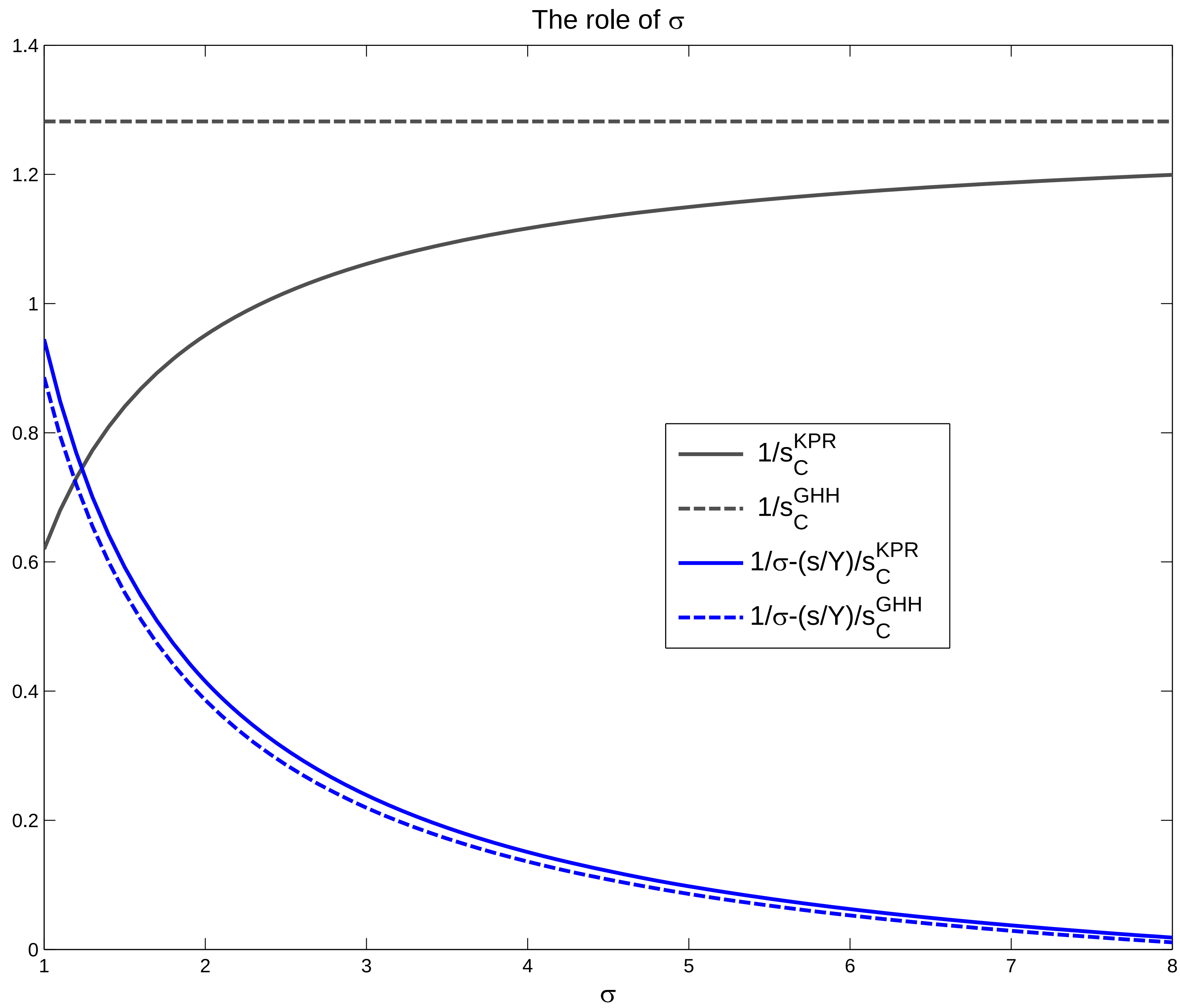
  which depends on the maturity structure through

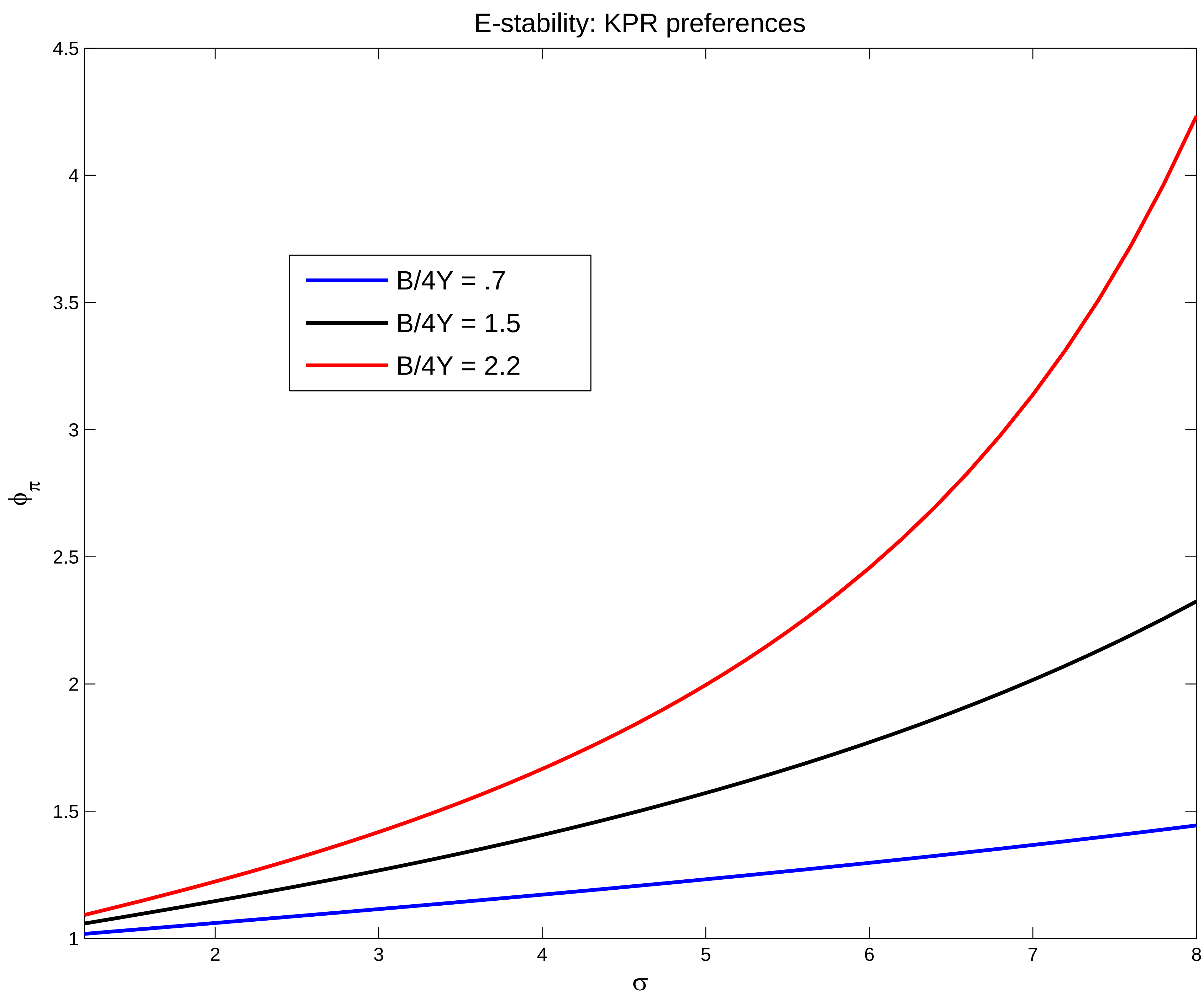
$$(1-\rho)\,\rho\beta \hat{E}_t \sum_{T=t}^{\infty} (\rho\beta)^{T-t}\,\phi_\pi \hat{\pi}_{T+1} = \frac{(1-\rho)\,\rho\beta}{1-\rho\beta}\phi_\pi \hat{E}_t \pi$$

  - For $\beta = 0.99$ the right hand side peaks $\rho \simeq 0.9$: average maturity of 2 years
  - For $\rho = 1$: infinite maturity debt dynamics independent of its own price.

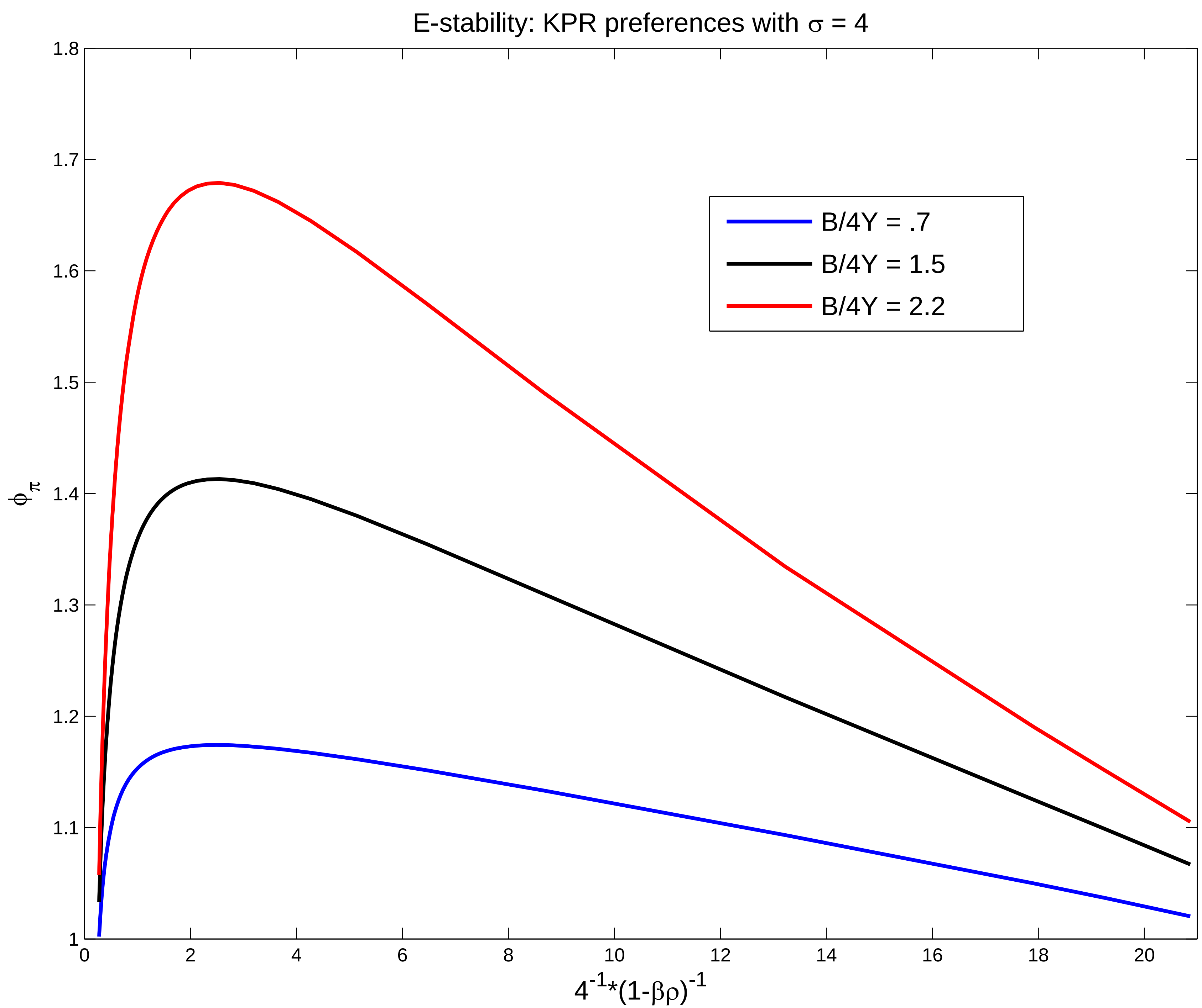
IES and Debt-to-Output Ratio



The role of σ
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1
2
3
4
5
6
7
8
σ
$1/s_C^{KPR}$
$1/s_C^{GHH}$
$1/\sigma-(s/Y)/s_C^{KPR}$
$1/\sigma-(s/Y)/s_C^{GHH}$



E-stability: KPR preferences
B/4Y = .7
B/4Y = 1.5
B/4Y = 2.2
φπ
σ
4.5
4
3.5
3
2.5
2
1.5
1
2
3
4
5
6
7
8



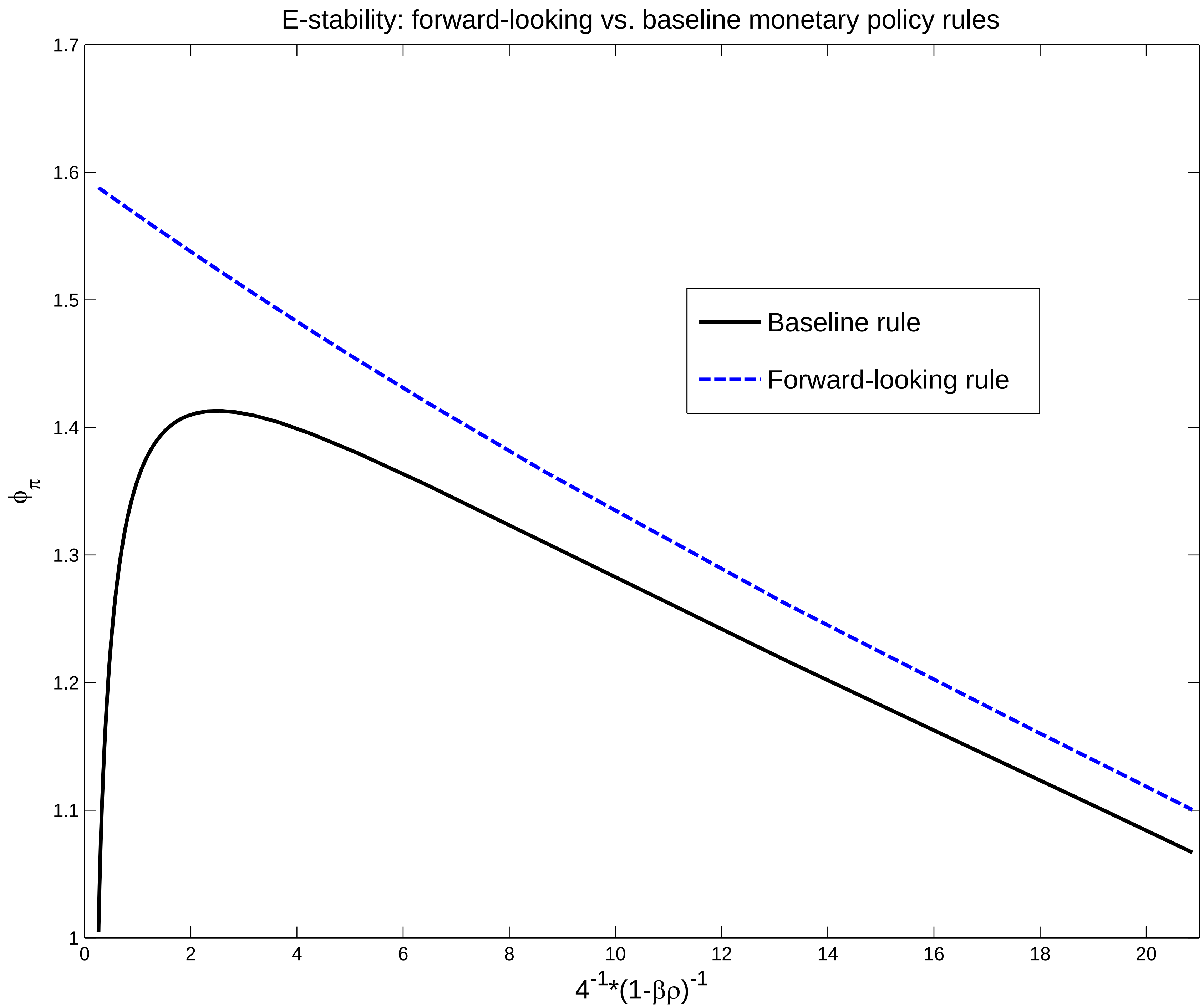
E-stability: KPR preferences with σ = 4
B/4Y = .7
B/4Y = 1.5
B/4Y = 2.2
φ_π
4^-1*(1-βρ)^-1
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0
2
4
6
8
10
12
14
16
18
20

Forward-looking policy rules

- Alternative policy rules that responds to expectations

$$\hat{\imath}_t = \phi_\pi \hat{E}_t \hat{\pi}_{t+1}$$

- Here we assume that agents know the policy rule



E-stability: forward-looking vs. baseline monetary policy rules
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0
2
4
6
8
10
12
14
16
18
20
ϕ_π
$4^{-1}*(1-\beta\rho)^{-1}$
Baseline rule
Forward-looking rule

Intuition: Debt Dynamics

- Using the bond price equation and the monetary policy rule, $\hat{\imath}_t = \phi_\pi \hat{E}_t \hat{\pi}_{t+1}$, permits the evolution of real debt to be written as

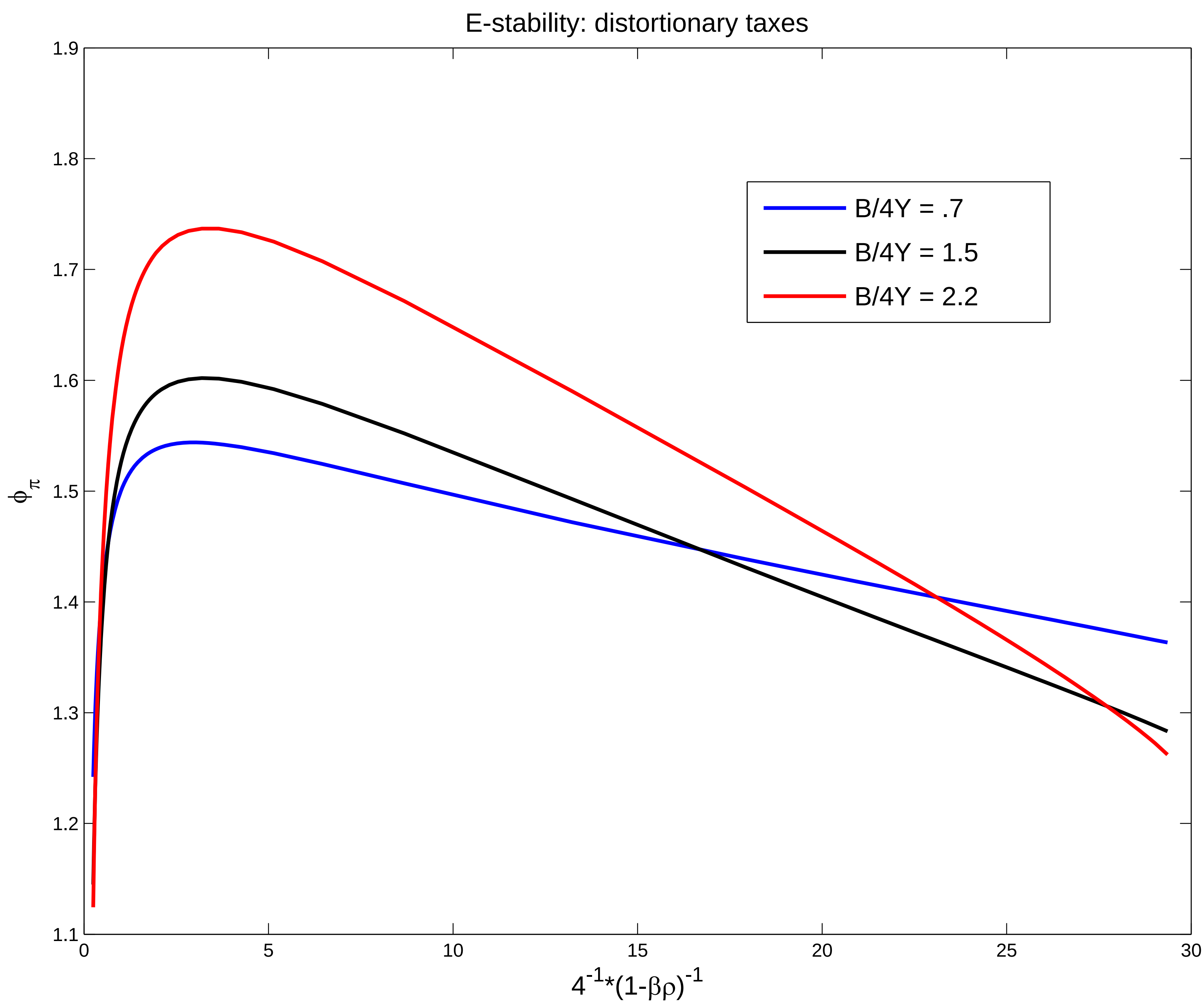
$$\hat{b}_t^m = \beta^{-1}\left(\hat{b}_{t-1}^m - \hat{\pi}_t\right) + (1-\rho)\,\phi_\pi \hat{E}_t \hat{\pi}_{t+1} - \left(\beta^{-1} - 1\right)\hat{s}_t$$

$$+ (1-\rho)\,\rho\beta \hat{E}_t \sum_{T=t}^{\infty} (\rho\beta)^{T-t}\,\phi_\pi \hat{\pi}_{T+2}$$

  - Debt depends on expectations regardless of ρ
  - Destabilizing effects on consumption and debt decline monotonically with ρ

Distortionary taxation

- Consider the model labor taxes (τ_t^w)...
- ...and assume now: $\sigma^{-1} = 1/2$



E-stability: distortionary taxes
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
0
5
10
15
20
25
30
ϕ_π
$4^{-1}*(1-\beta\rho)^{-1}$
B/4Y = .7
B/4Y = 1.5
B/4Y = 2.2

Intuition: Distortionary taxation

- Same mechanism as before but with a ‘twist’

- Phillips curve has an extra term

$$\begin{aligned}\hat{\pi}_t &= \psi\left[\left(\gamma + \frac{\bar{Y}}{\bar{C}}\iota\right)\hat{Y}_t + \frac{\bar{\tau}^w}{(1-\bar{\tau}^w)}\hat{\tau}_t^w\right] + \\ &\quad \hat{E}_t \sum_{T=t}^{\infty} (\alpha\beta)^{T-t}\left[\psi\alpha\beta\hat{w}_{T+1} + (1-\alpha)\beta\hat{\pi}_{T+1}\right]\end{aligned}$$

- Changes in tax rates as cost-push “shocks”, reinforcing the drift in expectations

Conclusion

- Uncertainty about policy regime can induce drift in expectations

- High debt levels and short to medium maturity debt induce instability
  - Instability generated through wealth effects

- Fundamentally changes the nature of household and firm responses to shocks — even if expectations stable in the long-run

- In such a world fiscal communication stabilizing