Asset Purchases and Default-Inflation Risks in Noisy Financial Markets

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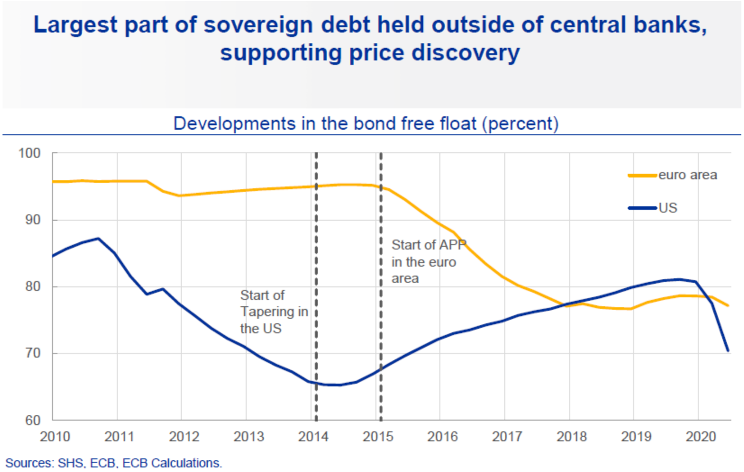
CSEF-IGIER Symposium on Economics and Finance
Capri, 23 June 2022

Motivation

"The shadow of fiscal dominance: misconceptions, perceptions and perspectives"
Isabel Schnabel, September 11th 2020



Asset Purchases (APs)

in practice and in theory

- APs in practice:
  - effective in compressing returns
  - *narrow* rather than *broad* effects
  - state-contingent: $\uparrow$ uncertainty & $\uparrow$ distress $\rightarrow$ APs $\uparrow$ effective

- APs in theory:
  - Macro: Wallace neutrality $\longleftrightarrow$ Finance: Preferred-Habitat Traders
  - many models, many details
  - two key features:
    - Heterogeneity
    - Limits to Arbitrage

This Paper

How APs work in theory with a new, *tight* mechanism

- `H`**eterogeneity**: dispersed information (& learning from prices)
- `L`**imits to** `A`**rbitrage**: bounds on asset positions

We show

- `H` **or** `LA` $\Rightarrow$ AP neutrality
- `H` **and** `LA`
  - APs crowd out investors who are pessimistic/under-price the asset
  - asset price $\uparrow$, consistent with empirical literature
  - asymmetric effect on price informativeness

  $\Rightarrow$ **most effective AP policy is > 0 & bounded**
- comparative statics wrt: fundamentals, public info, private info
- applications to fiscal-monetary interactions and endogenous default

Literature

- Irrelevance results under complete info & frictionless markets
  - Wallace (1981), Backus Kehoe (1989)
- Information frictions
  - Mussa (1981), Jeanne Svensson (2007), Bhattarai et al. (2015), Iovino Sergeyev (2021)
- Market segmentation
  - Curdia Woodford (2011), Gertler Karadi (2015), Gabaix Maggiori (2015), Vayanos Vila (2021)
  - Chen et al. (2012), Reis (2017), Auclert (2019), Sterk Tenreyro (2018), Cui Sterk (2021)

Outline

- Basic model: Exogenous Asset Payoff
- (Sketch of) Extensions
- Final Discussion

Basic Model

- Asset: govt debt, random gross supply: $b = S \sim U[0,1]$
- Asset payoff driven by stochastic + unobserved fundamental $\theta = \begin{cases} \theta^H & \text{w.p. } q \\ \theta^L & \text{w.p. } 1-q \end{cases}$
  $\rightarrow$ high/low inflation (U.S.) or repay/default (periph. EU)
- Continuum of *risk-neutral* investors $i \in [0,1]$ solve

$$\max_{b_i, c_i} \quad \mathbb{E}[\, c_i \,|\, \Omega_i \,]$$
$$\text{s.t.} \quad c_i = b_i R\theta + (1 - b_i)1 + \tau$$
$$b_i \in [0,1]$$

- AP *rule*: buy share $\alpha \in [0,1)$ of realised S, profits transferred to investors (τ)
- Our Target: see how α impacts **ex-ante asset return** $\mathbb{E}[R\theta]$
  - govt debt service & tax distortions
  - real interest rates as MP target per se

Individual Strategies

- Agent i's information set Ω_i
  - private signal $x_i = \theta + \sigma_x \xi_i$, where $\xi_i \sim N(0,1)$
  - market price R

- Agent i's strategy

$$R\,\mathbb{E}[\,\theta\,|\,x_i,\,R] \begin{cases} > 1 & b_i = 1 \\ = 1 & b_i \in [0,1] \\ < 1 & b_i = 0 \end{cases}$$

- Subjective beliefs $\mathbb{E}[\,\theta\,|\,\boldsymbol{x_i},\,R]$ are $\uparrow$ in x_i

Market Clearing and Market Signal

- Monotone threshold strategies: investors buy bonds iff $x_i \geq \widehat{x}(R, \alpha)$
- Bond market clearing

$$\underbrace{\Phi\left(\frac{\theta - \widehat{x}(R,\alpha)}{\sigma_x}\right)}_{\text{private bond demand}} = \underbrace{(1-\alpha)S}_{\text{net bond supply}}$$

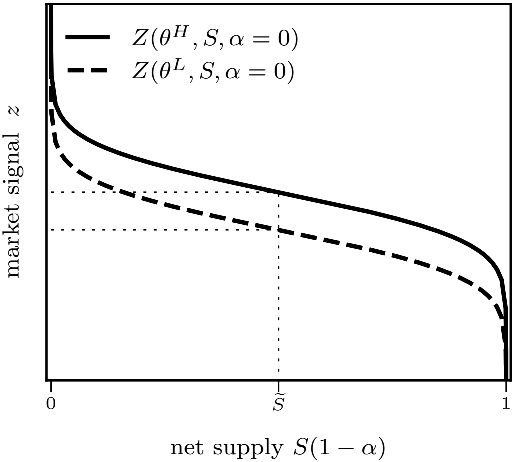
$$\int b_i di = P(x_i > \widehat{x}(R,\alpha))$$

- Solving for the equilibrium cutoff signal

$$\underbrace{\widehat{x}(R,\alpha)}_{\substack{\text{price signal} \\ \Leftrightarrow \\ \text{marginal agent's} \\ \text{private signal}}} = \underbrace{\theta - \sigma_x \Phi^{-1}\left(S(1-\alpha)\right)}_{\substack{\text{exogenous fn of} \\ \text{shocks } (\theta, S)}}$$

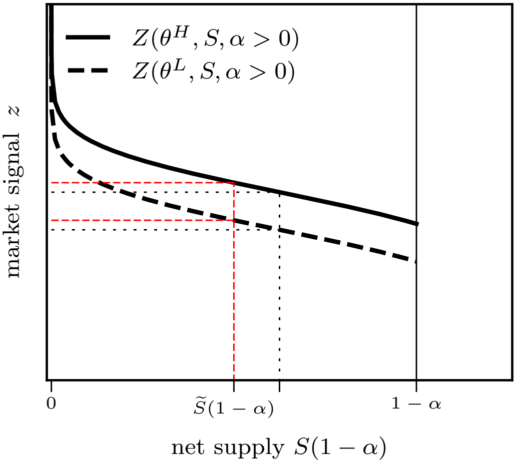
$$:= \boldsymbol{Z(\theta, S, \alpha)}$$

Market Signal Without APs



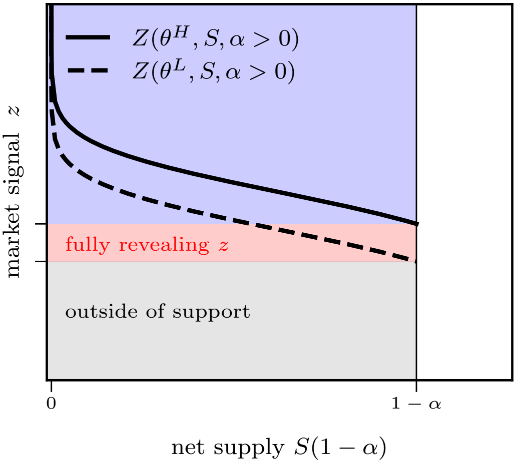
Market Signal With APs

Leveraging Optimism



Market Signal With APs

Crisis Revelation



Market Prices and Average Bond Returns

- Observing $R \Leftrightarrow$ observing z

- Marginal agent's indifference condition pins down equilibrium R

$$R\,\mathbb{E}[\theta \mid \boldsymbol{x_i = z}, z, \alpha] = 1$$

- The market overweights the market signal $\boldsymbol{z}$ vs external observer w/out private info
  - For large $\boldsymbol{z}$ the market **over**values the $\theta-$lottery
  - For small $\boldsymbol{z}$ the market **under**values the $\theta-$lottery

Wegde Ratio

- Expected payoffs

$$\mathbb{E}[\theta \mid \boldsymbol{x_i} = \boldsymbol{z}, z, \alpha] = \int \theta \; f(\theta \mid \boldsymbol{x_i} = \boldsymbol{z}, z, \alpha) \; d\theta \qquad \text{(Market/marginal agent's)}$$

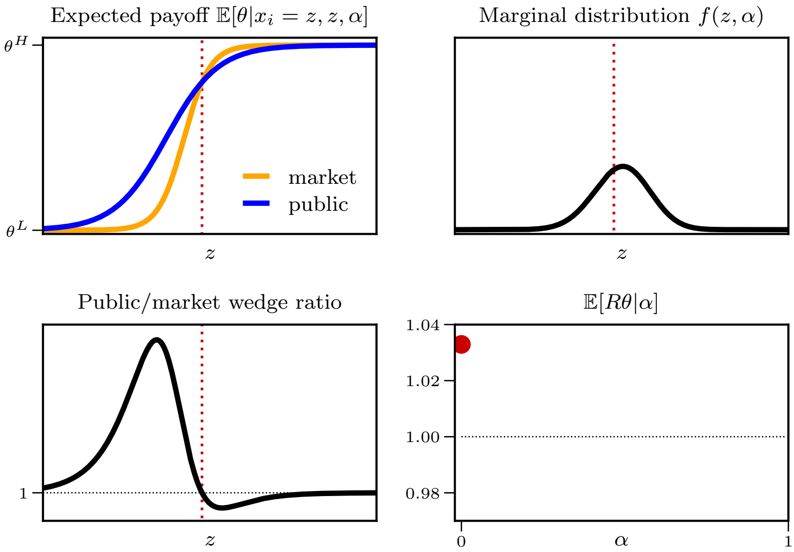
$$\mathbb{E}[\theta \mid \boldsymbol{z}, \alpha] = \int \theta \; f(\theta \mid \boldsymbol{z}, \alpha) \; d\theta \qquad \text{(Public)}$$

- The average bond return is

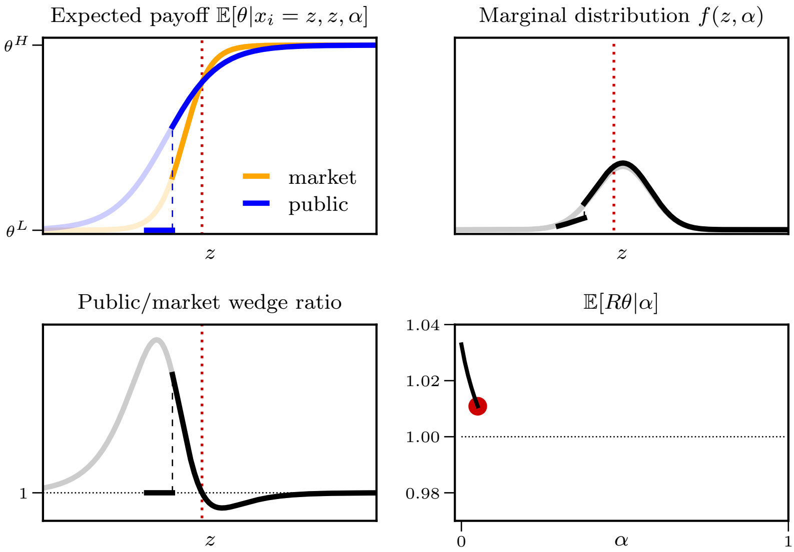
$$\mathbb{E}\left[R\theta|\alpha\right] = \mathbb{E}\Big[\,\mathbb{E}[R\theta \mid z] \;|\alpha\Big] = \int \frac{\int \theta \; f(\theta|z,\alpha) \; d\theta}{\int \theta \; f(\theta \mid \boldsymbol{x_i} = \boldsymbol{z}, z, \alpha) \; d\theta} \; f(z,\alpha) dz \neq \mathbf{1}$$

- **Wedge** $\dfrac{\mathbb{E}[\theta|z,\alpha]}{\mathbb{E}[\theta|x_i = z, z, \alpha]}$ is the conditional (on $\boldsymbol{z}$) objective payoff/market price ratio
- Now look at wedge distribution in $\boldsymbol{z}$-space

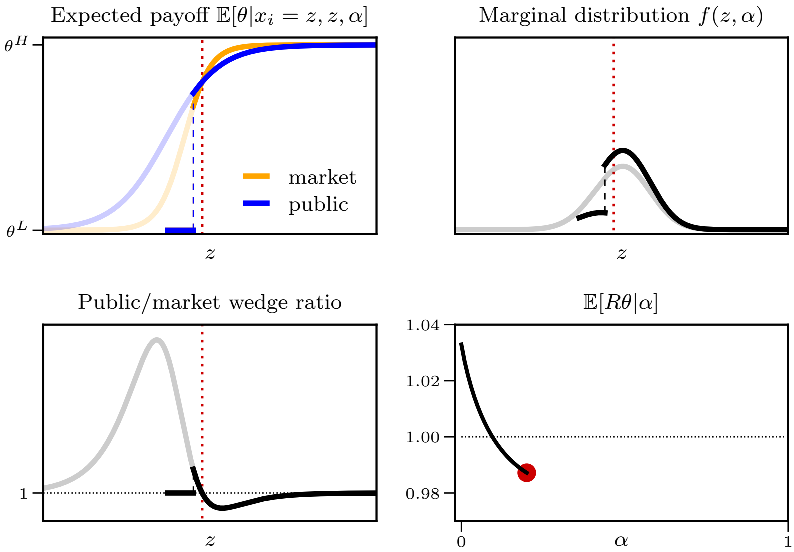
Wegde Ratio without APs ($\alpha = 0$)



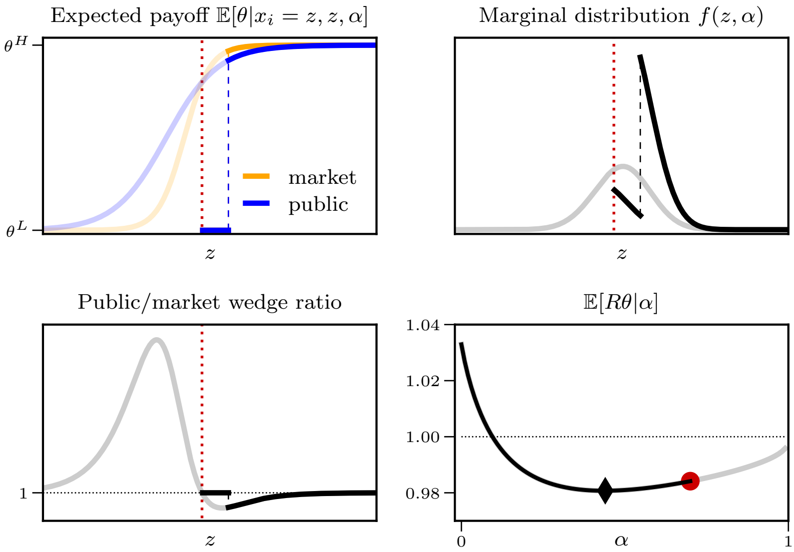
Wegde Ratio with APs ($\alpha = 0.05$)



Wegde Ratio with APs ($\alpha = 0.2$)



Wegde Ratio with APs ($\alpha = 0.7$)



Neutrality

- Consider problem of agent $i \in (0,1)$

$$\max_{c_i, b_i \in \mathbb{R}^2} \mathbb{E}[u(c_i)|\Omega_i] \quad \text{s.t.} \quad c_i = b_i R\theta + (1 - b_i)1 + \tau$$

- Asset market clearing: $\int b_i di + b_{cb} = S$
- Profits of AP authority: $\tau = b_{cb}(R\theta - 1)$

$\Rightarrow$ Household's BC becomes: $c_i = \boldsymbol{(b_i + b_{cb})} R\theta + (1 - b_i)1 - b_{cb}$

(a) Limits to arbitrage ($b_i \in [\underline{b}, \bar{b}]$) + No info frictions ($\Omega_i = \Omega$)
   - RA market clearing, $c_i = c$, all agents on EE $\rightarrow$ $\mathbb{E}[u'(c)(R\theta - 1) \mid \Omega] = 0$

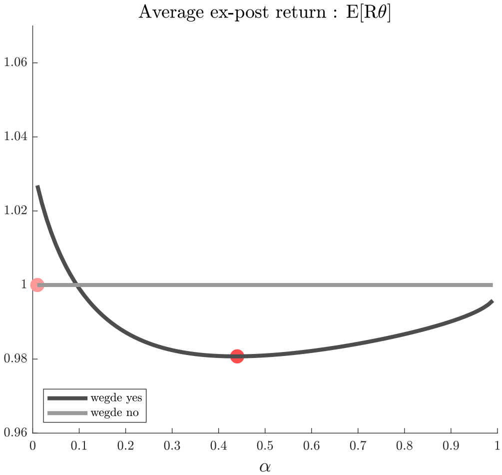
(b) No limits to arbitrage + Info frictions
   - Each i on own EE, interior solution for each i $\rightarrow$ $\mathbb{E}[u'(c_i)(R\theta - 1) \mid \Omega_i] = 0$

$\Rightarrow$ **Homogeneous crowding out, APs irrelevant**

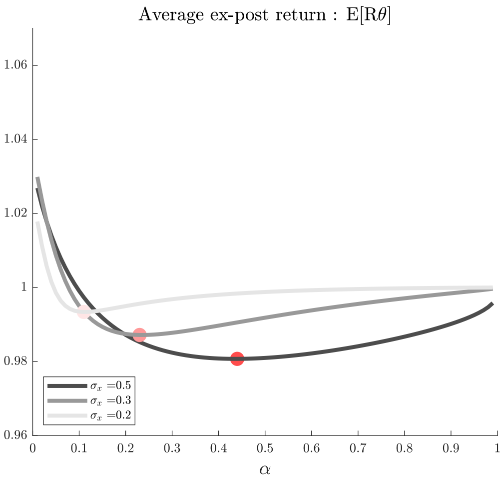
intro

Comparative Statics: State-Dependency

State-dependency of AP

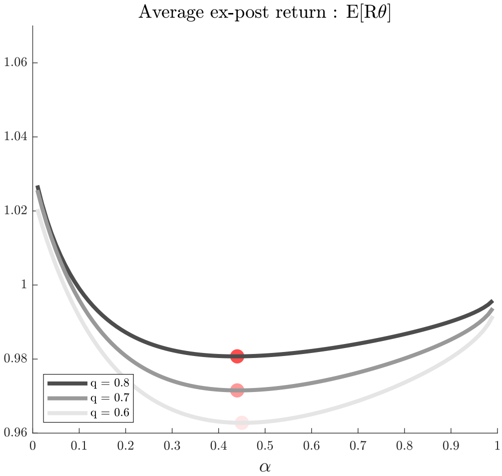


State-dependency of AP



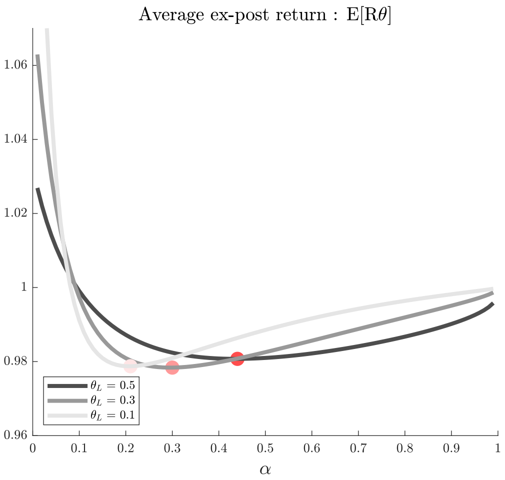
More private uncertainty: requires more APs and APs are more effective.

State-dependency of AP



More likely crisis: APs are more effective.

State-dependency of AP



Deeper crisis: requires less APs.

Extension:
APs, Fiscal-Monetary Interactions
and Endogenous Default

Fiscal-Monetary Interactions & Endogenous Default

Environment

- Two periods. Government, households, central bank
- $t = 0$
  - Government issues debt to finance random spending shock
  - Central bank issues money to buy debt or store ($\alpha := \frac{b^{cb}}{m}$)
  - Households invest endowment in debt, money or storage
- $t = 1$
  - Government raises taxes to repay debt, makes transfer to CB, may default

    $\Rightarrow$ **govt debt service = taxes**
  - Taxes are distortionary
  - Central bank uses asset returns to repay money
  - Households consume
- For now, assume default is exogenous

APs and Fiscal-Monetary Interactions

- Inflation
  - with govt-CB transfers, monetary dominance

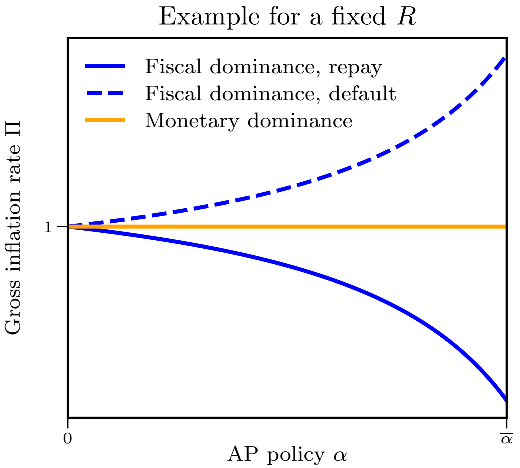
$$\frac{1}{\Pi} = 1$$

  - without transfers, fiscal dominance

$$\frac{1}{\Pi} = (1 - \alpha) + \alpha \frac{R\theta}{\Pi} \qquad \to \qquad \frac{1}{\Pi} = \frac{1 - \alpha}{1 - \alpha R\theta}$$

$\Rightarrow$ inflation risk endogenous to default risk via CB's exposure

Fiscal vs Monetary Dominance



Equilibrium Price and Welfare

- The asset payoff is now a nonlinear function of θ, R, α

- Marginal agent's no-arbitrage condition

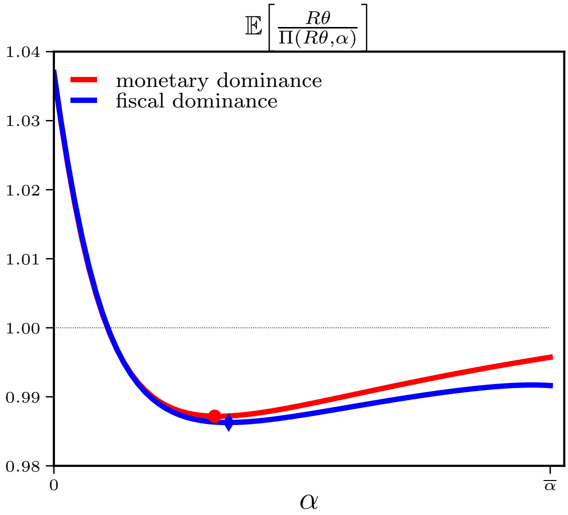
$$\mathbb{E}\left[\frac{R\theta}{\Pi(R\theta,\alpha)}|x_i = z, z, \alpha\right] = 1$$

- Welfare loss

$$\int\int \zeta\left(\frac{R\theta}{\Pi(R\theta,\alpha)}\right) f(\theta|z)\mathrm{d}\theta\, f(z)\mathrm{d}(z)$$

(omitting dependencies: $R(z,\alpha), f(\theta|z,\alpha), f(z|\alpha)$)

Tax Distortions and Welfare Loss



Endogenous Default

- Assume monetary dominance for simplicity ($\Pi = 1$)
- The fundamental is the default deadweight loss $\phi(\theta)$
- Default decision $\delta = 1$ with haircut h if

$$\zeta\Big(R\Big) \geq \zeta\Big(R(1-h)\Big) + \phi(\theta) \qquad \Leftrightarrow \qquad \theta < \widehat{\theta}(R, \alpha)$$

- Marginal agent's no-arbitrage condition

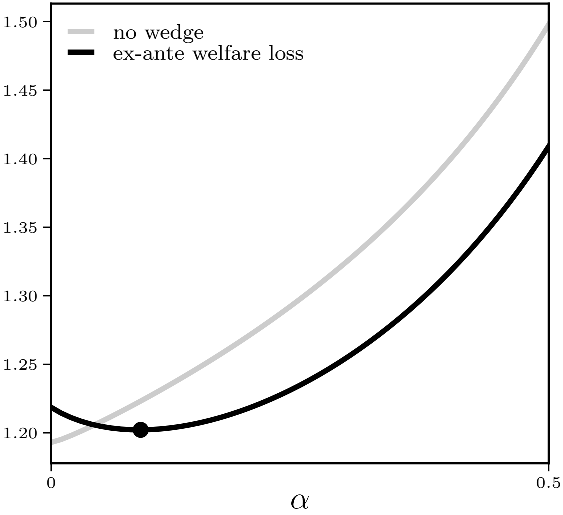
$$R\Big[1 - h\,\text{Prob}\Big(\theta < \widehat{\theta}(R, \alpha) | x_i = z, z, \alpha\Big)\Big] = 1$$

- Welfare loss

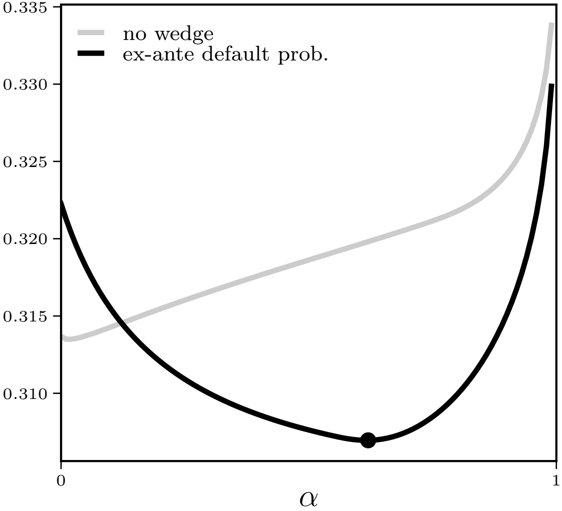
$$\int\int \Big[\zeta\Big(R(1-\delta h)\Big) + (1-\delta)\phi(\theta)\Big]\, f(\theta|z)\mathrm{d}\theta\; f(z)\mathrm{d}(z)$$

(omitting dependencies: $R(z,\alpha), \delta(\theta, R, \alpha), f(\theta|z,\alpha), f(z|\alpha)$)

Total Welfare Loss



Default Frequency



Final Discussion

Conclusions

- An asset price mechanism where APs
  - are non-neutral
  - change the conditional distribution of market wedges
  - affect the information contained in market prices

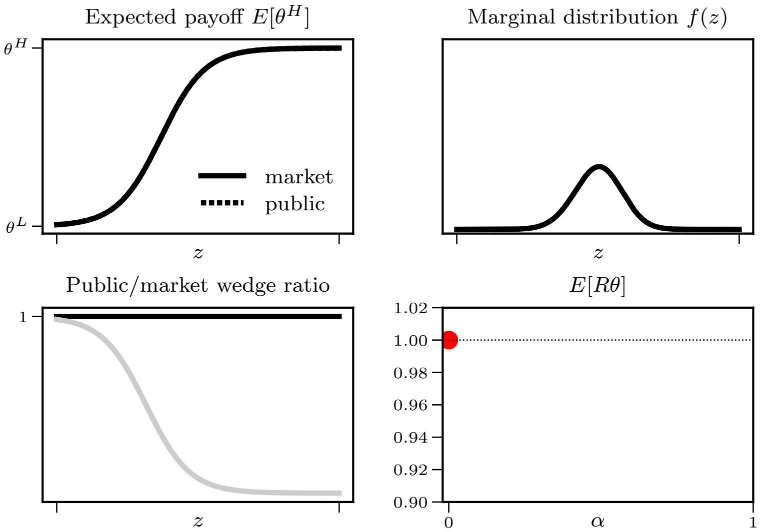
- We capture two essential features of many applied models:
  - (belief) heterogeneity
  - limits to individual arbitrage

- APs effectiveness is state contingent
  - more effective if crisis is deeper or more likely

- Many possible applications (stay tuned...)
  - fiscal-monetary interactions and APs of defaultable debt
  - endogenous govt default
  - monetary policy with sticky prices

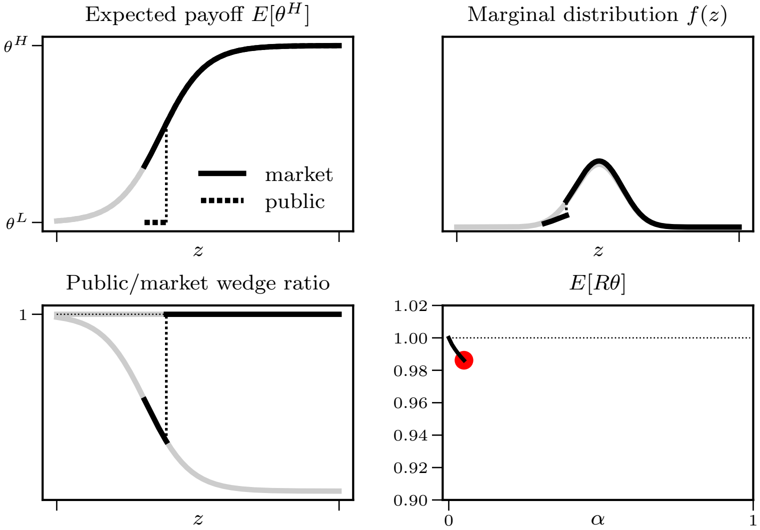
Wegde Ratio without AP $\alpha = 0$

No learning from prices



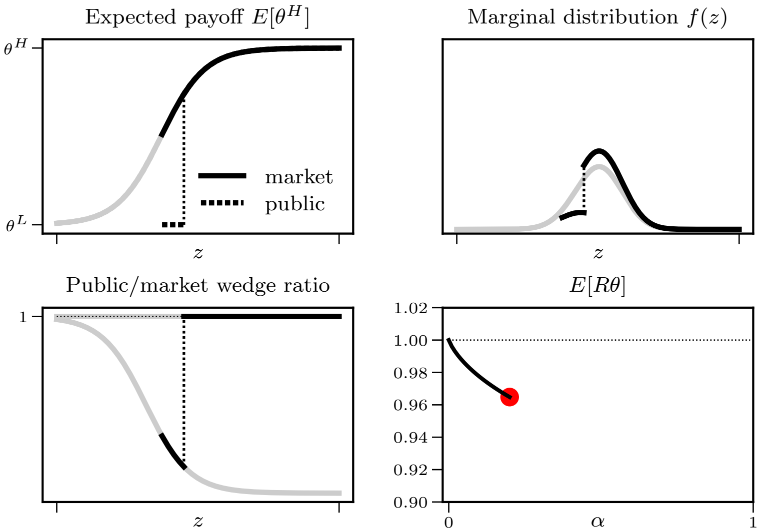
Wegde Ratio with AP $\alpha = 0.05$

No learning from prices



Wegde Ratio with AP $\alpha = 0.2$

No learning from prices



Wegde Ratio with AP $\alpha = 0.7$

No learning from prices