Sovereign Risk and Bank Risk-Taking

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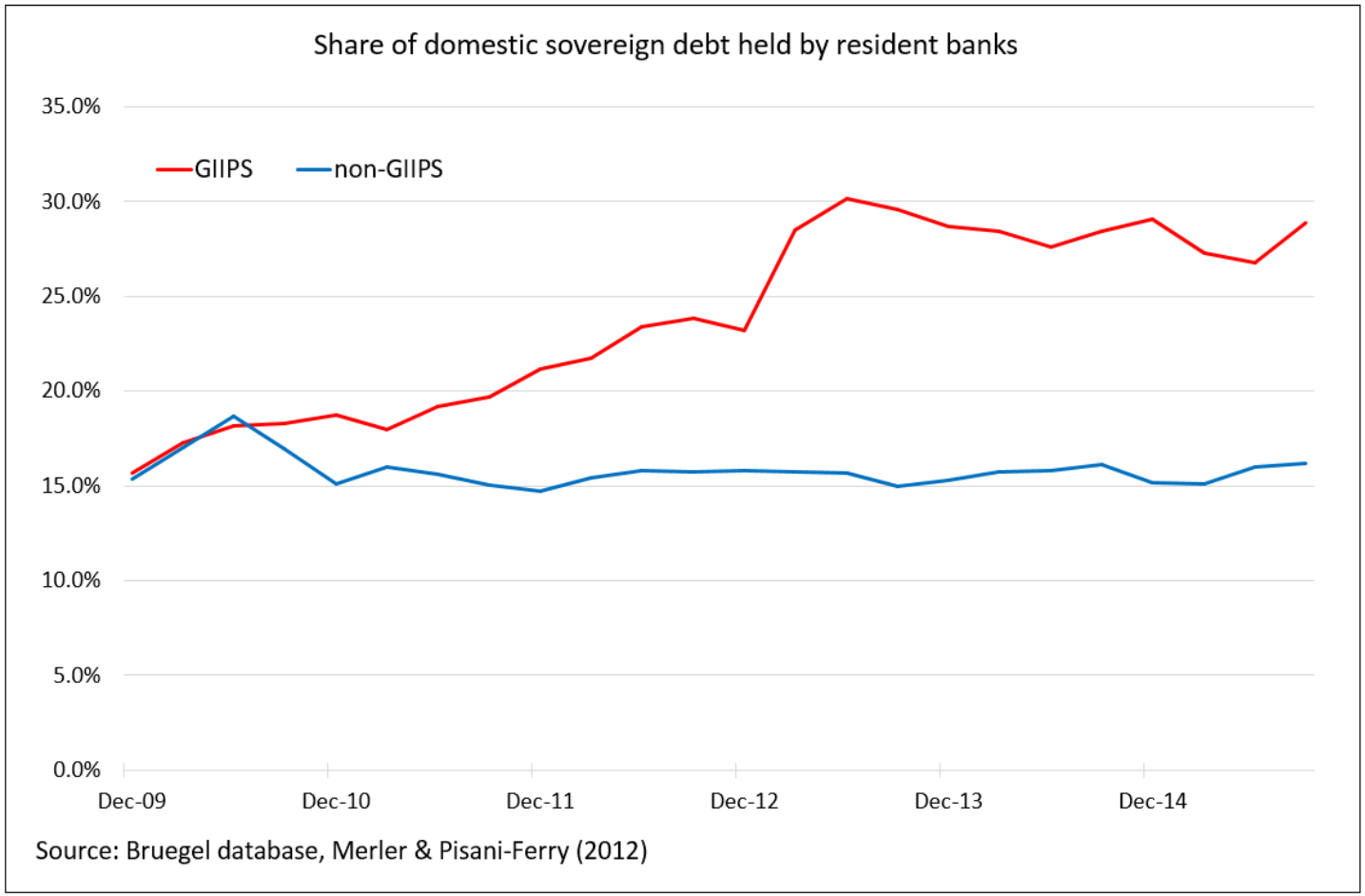
Motivation

In countries hit by the sovereign debt crisis, the share of domestic sovereign debt held by the national banking system has sharply increased



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- Crowding out of bank lending
- Deposit outflows
- Diabolic loop

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What are the causes behind this?

- Model the optimal response of banks and depositors to a sovereign debt crisis
- Formal framework to evaluate recent policy interventions

Overview

Gambling on domestic sovereign debt

- Limited liability
- Small non-bond cost in case of domestic government's default

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Gambling equilibrium

- Crowding out, rise in bank funding costs
- Sovereign default endogenously leads to a banking crisis

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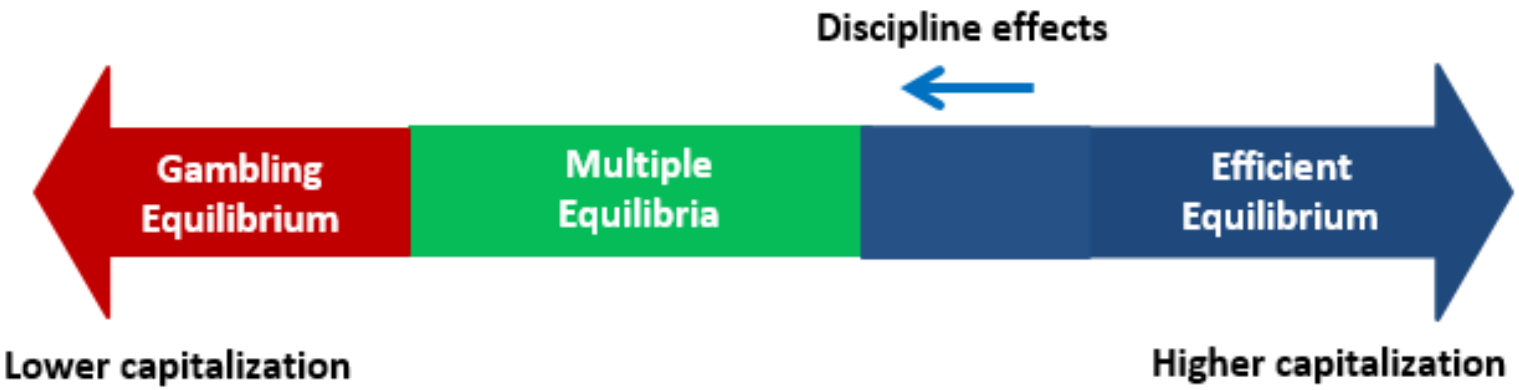
Optimal response of depositors to insolvency risk

- Incomplete (or non-credible) deposit insurance
- Discipline effect: deters banks from gambling
- Multiplicity when bank balance sheets intransparent

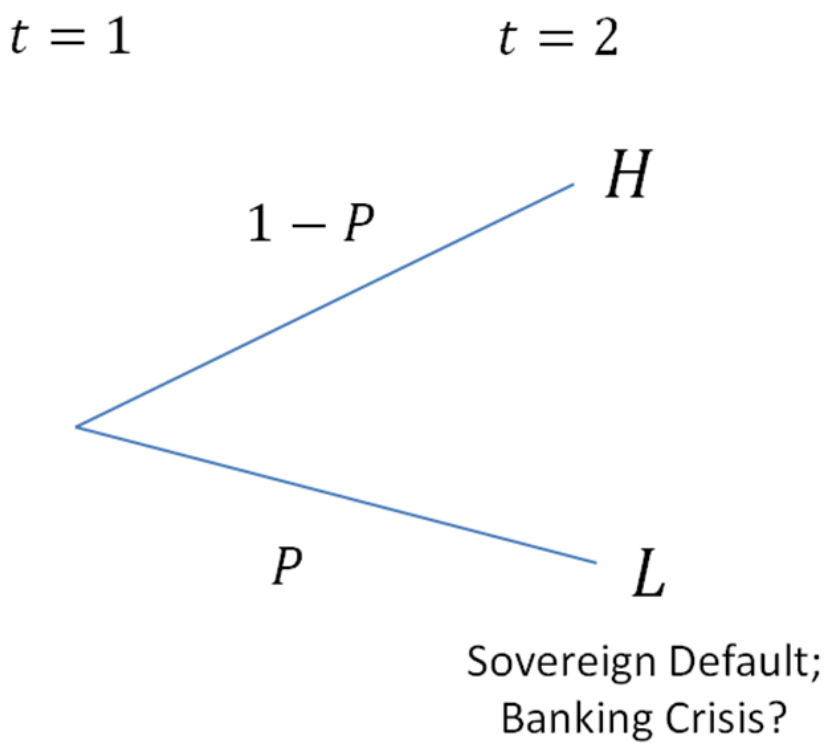
Overview


Discipline effects
Gambling Equilibrium
Multiple Equilibria
Efficient Equilibrium
Lower capitalization
Higher capitalization

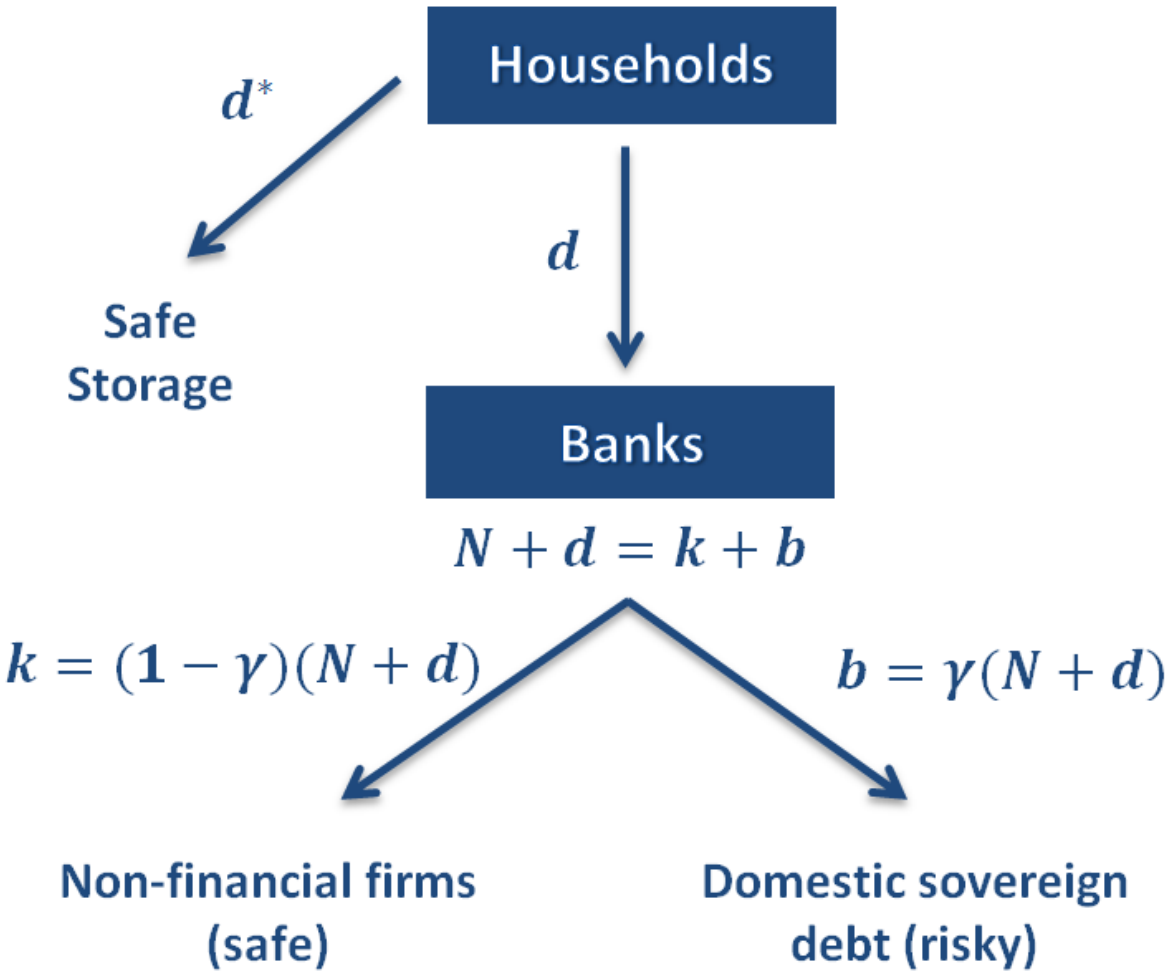
Model

Stylized model of small open economy in currency union

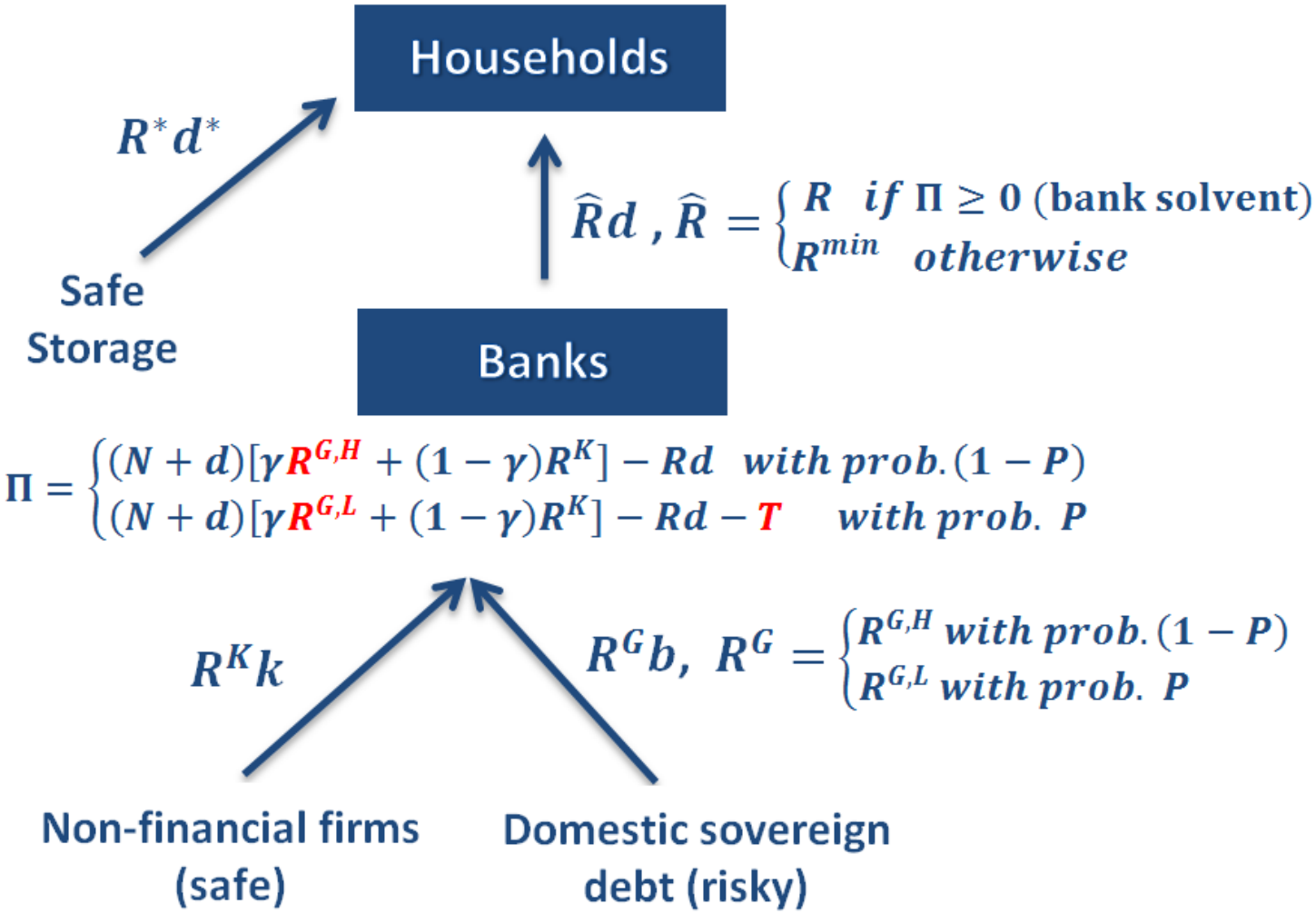
- Households, banks, non-financial firms
- Sovereign default exogenous with probability P
- Endogenous determination of banking crisis



Period 1


Households
d^*
d
Safe Storage
Banks
$N + d = k + b$
$k = (1 - \gamma)(N + d)$
$b = \gamma(N + d)$
Non-financial firms (safe)
Domestic sovereign debt (risky)

Period 2


Households
$R^* d^*$
$\hat{R}d\ ,\ \hat{R} = \begin{cases} R & if\ \Pi \geq 0\ (\text{bank solvent}) \\ R^{min} & otherwise \end{cases}$
Safe Storage
Banks
$\Pi = \begin{cases} (N+d)[\gamma R^{G,H} + (1-\gamma)R^K] - Rd & with\ prob.\ (1-P) \\ (N+d)[\gamma R^{G,L} + (1-\gamma)R^K] - Rd - T & with\ prob.\ P \end{cases}$
$R^K k$
$R^G b,\ R^G = \begin{cases} R^{G,H} & with\ prob.\ (1-P) \\ R^{G,L} & with\ prob.\ P \end{cases}$
Non-financial firms (safe)
Domestic sovereign debt (risky)

Deposit Threshold

- Solvency condition under sovereign default

$$\Pi = (N+d)\left[\gamma R^{G,L} + (1-\gamma)R^{K}\right] - Rd - T \geq 0$$

- Deposit threshold for solvency in case of sovereign default

$$\bar{d}(\gamma, R) = \frac{N\left[\gamma R^{G,L} + (1-\gamma)R^{K}\right] - T}{R - \left[\gamma R^{G,L} + (1-\gamma)R^{K}\right]}$$

- Solvency prospects depend on threshold

$$Pr[\Pi \geq 0] = \left\{ \begin{array}{c} 1 \quad \text{if } d \leq \bar{d}(\gamma, R) \\ 1 - P \text{ if } d > \bar{d}(\gamma, R) \end{array} \right\}$$

Households

- Standard Euler conditions

$$d: \quad u'(c_1) = \beta E\left[\hat{R}u'(c_2)\right]$$

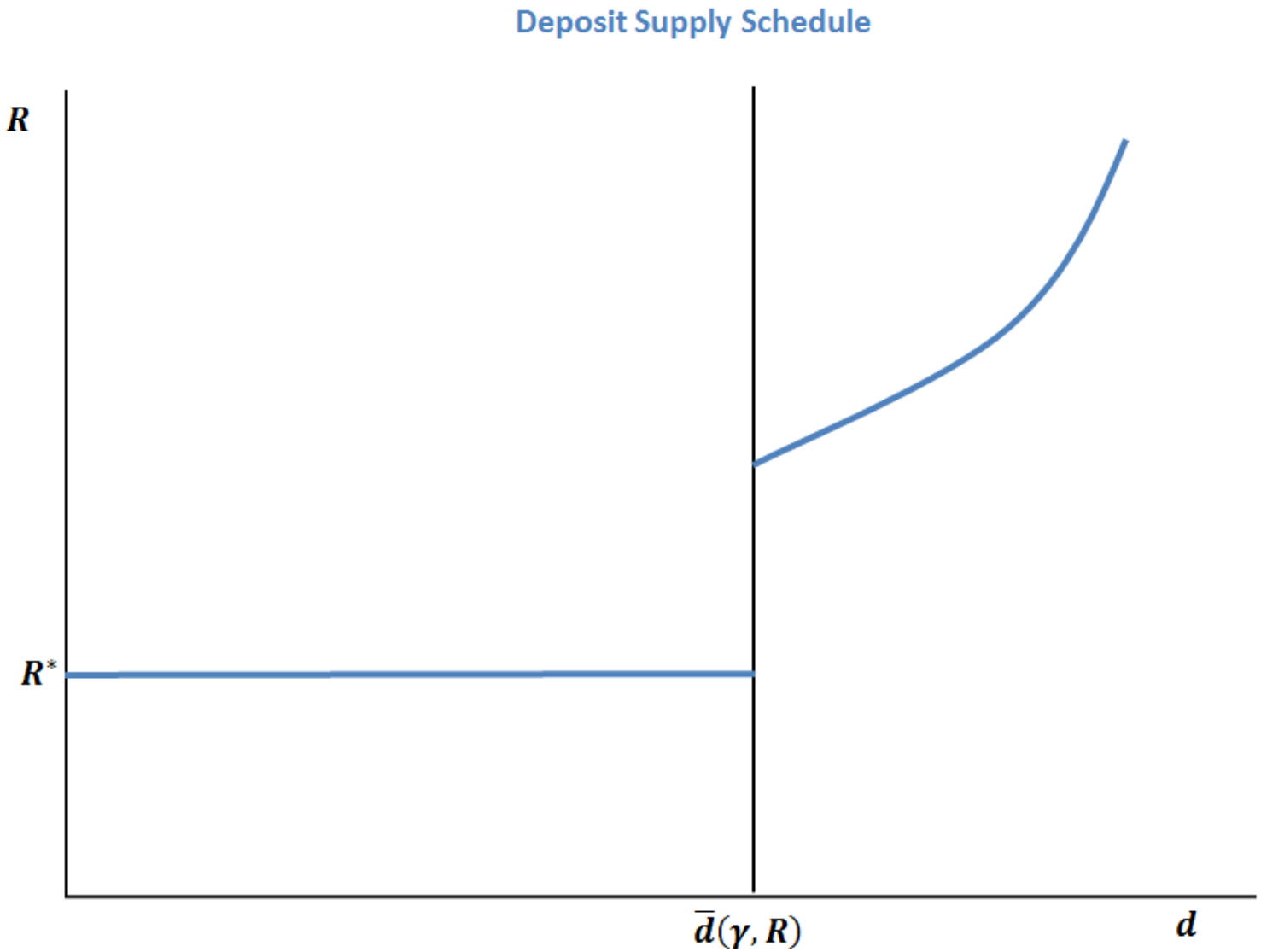
$$d^*: \quad u'(c_1) = \beta R^* E\left[u'(c_2)\right]$$

- R depends on bank's solvency prospects

$$R = R^* + \frac{1 - Pr\left[\Pi \geq 0\right]}{Pr\left[\Pi \geq 0\right]}\left(R^* - R^{min}\right) - \frac{Cov\left(\hat{R}, u'(c_2)\right)}{Pr\left[\Pi \geq 0\right] E\left[u'(c_2)\right]}$$

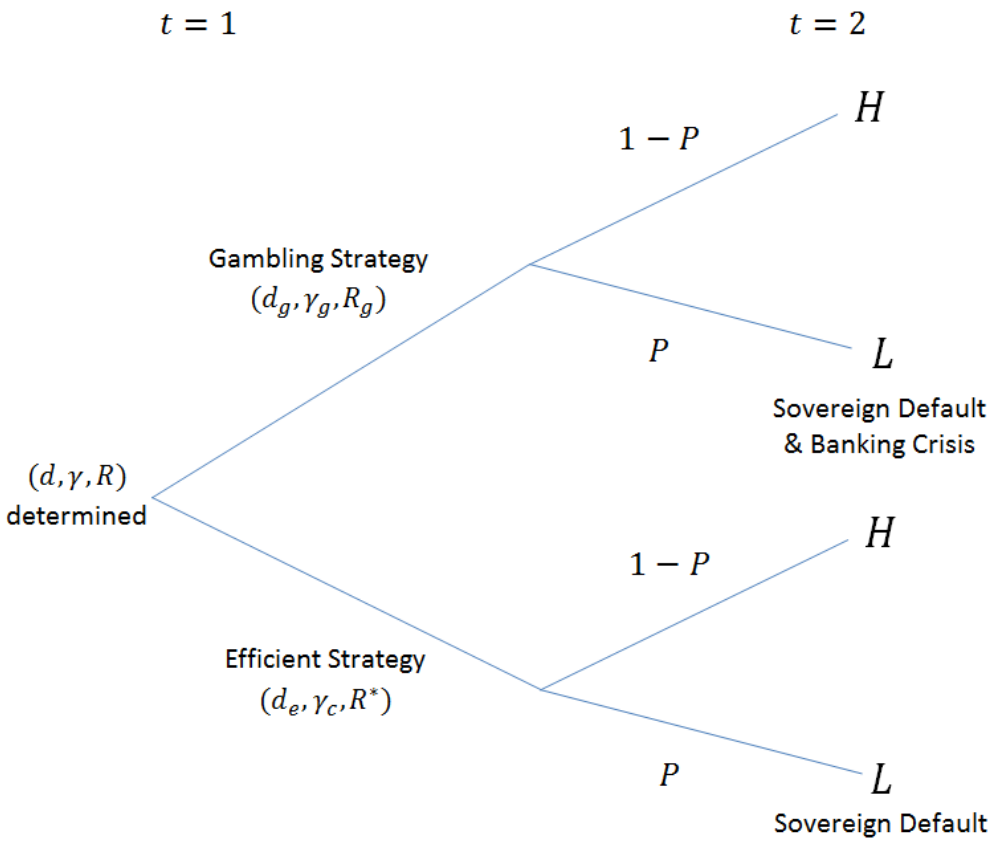
- Discontinuity in optimal deposit supply schedule

$$R = \left\{ \begin{array}{ll} R^* & \text{if } d \leq \bar{d}(\gamma, R) \\ R^* + \frac{P}{1-P}\left(R^* - R^{min}\right) - \frac{Cov\left(\hat{R}, u'(c_2)\right)}{(1-P)E[u'(c_2)]} & \text{if } d > \bar{d}(\gamma, R) \end{array} \right\}$$


Deposit Supply Schedule
R
R*
$\bar{d}(\gamma, R)$
d

Banks

- Imperfectly competitive (**Cournot**) with market share v
- Choose strategy with higher expected payoff, taking other banks' strategy as given



Efficient Strategy

- Limited liability never binds. Bank's problem:

$$\max_{d_e,\gamma_e} (N+d_e)\left[\gamma_e E[R^G]+(1-\gamma_e)R_e^K\right]-R^* d_e - PT$$

$$\text{s.t. } R_e^K = a(k_e+(1-v)K_e+g(k_e+(1-v)K_e))^{a-1}$$

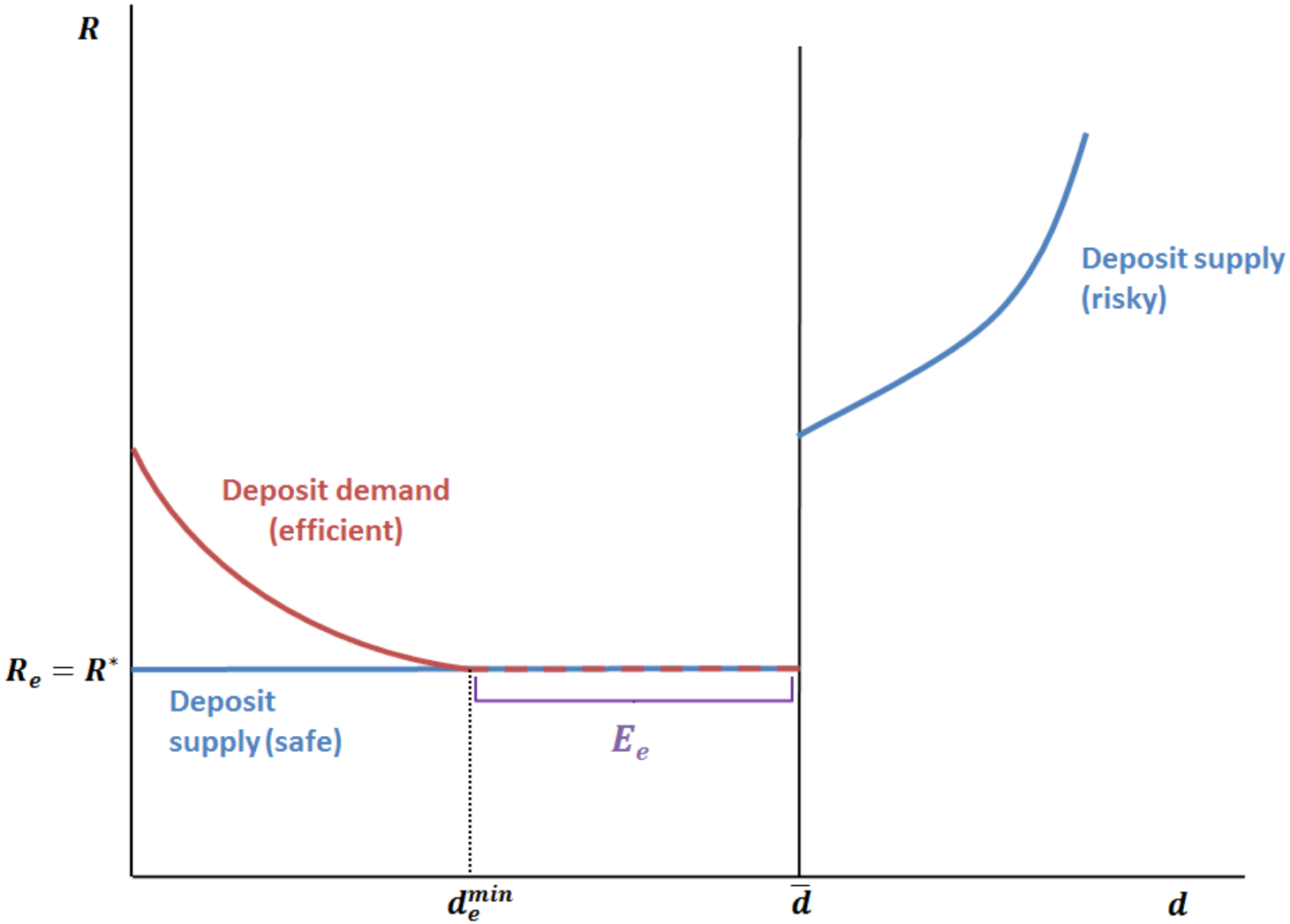
$$d_e \leq \bar{d}\,,\ \lambda_e \geq 0$$

- Deposit threshold as occassionally binding constraint
- First order conditions

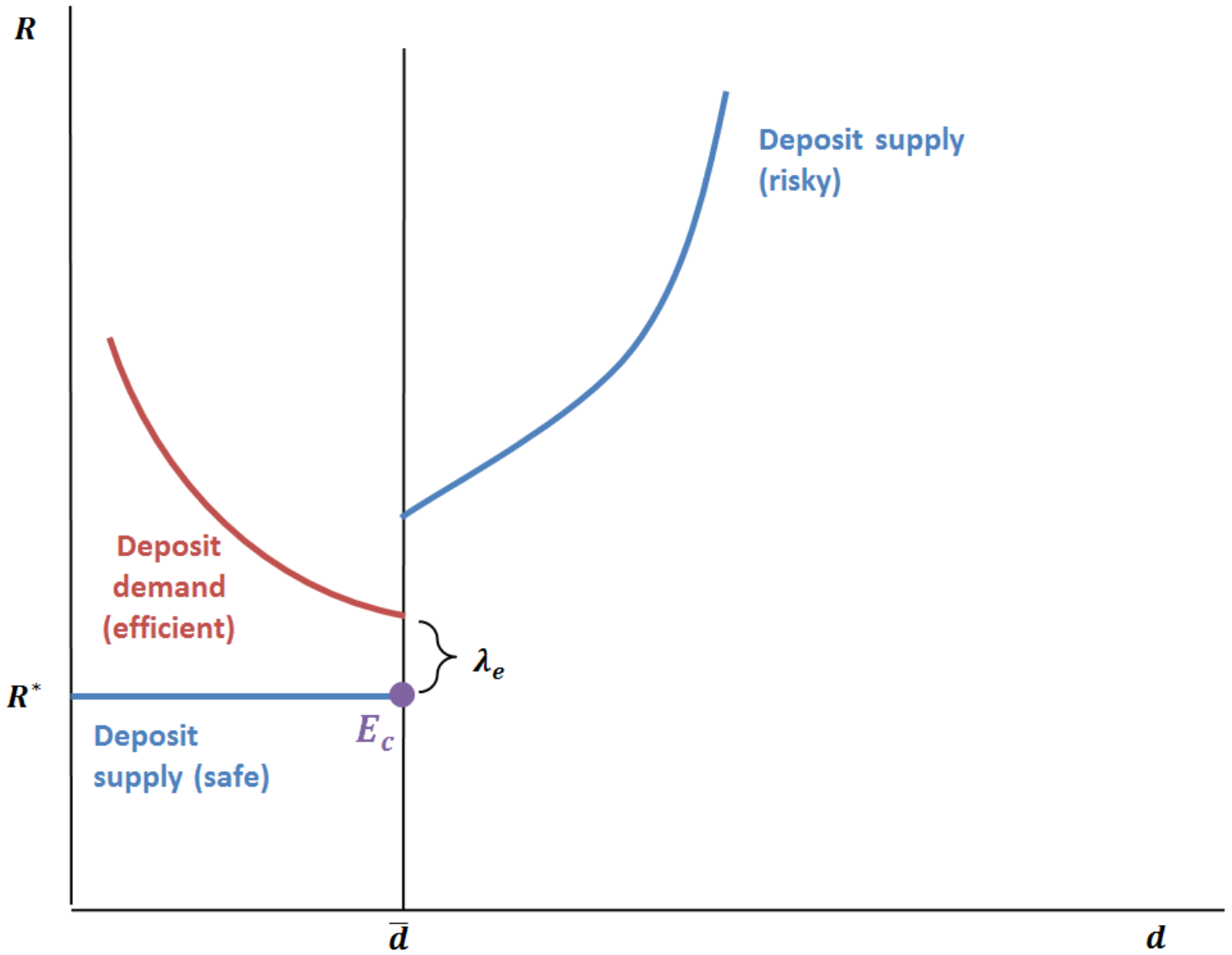
$$E\left[R^G\right] = R^* + \lambda_e$$

$$R_e^K = R^* + \mu_k(K_e) + \lambda_e$$

Efficient Strategy (unconstrained)



Efficient Strategy (constrained)



Gambling Strategy

- Limited liability binding in case of sovereign default

$$\max_{d_g,\gamma_g} (N+d_g)\left[\gamma_g R^{G,H} + (1-\gamma_g)R_g^K\right] - R_g d_g$$

s.t.

$$R_g^K = (k_g + (1-v)K_g + g(k_g + (1-v)K_g))$$

$$R_g = R^* + \frac{P}{1-P}\left(R^* - R^{min}\right) - \frac{Cov\left(\hat{R}, u'(c_2)\right)}{(1-P)E\left[u'(c_2)\right]}$$

- Market power in deposit market

Gambling Strategy

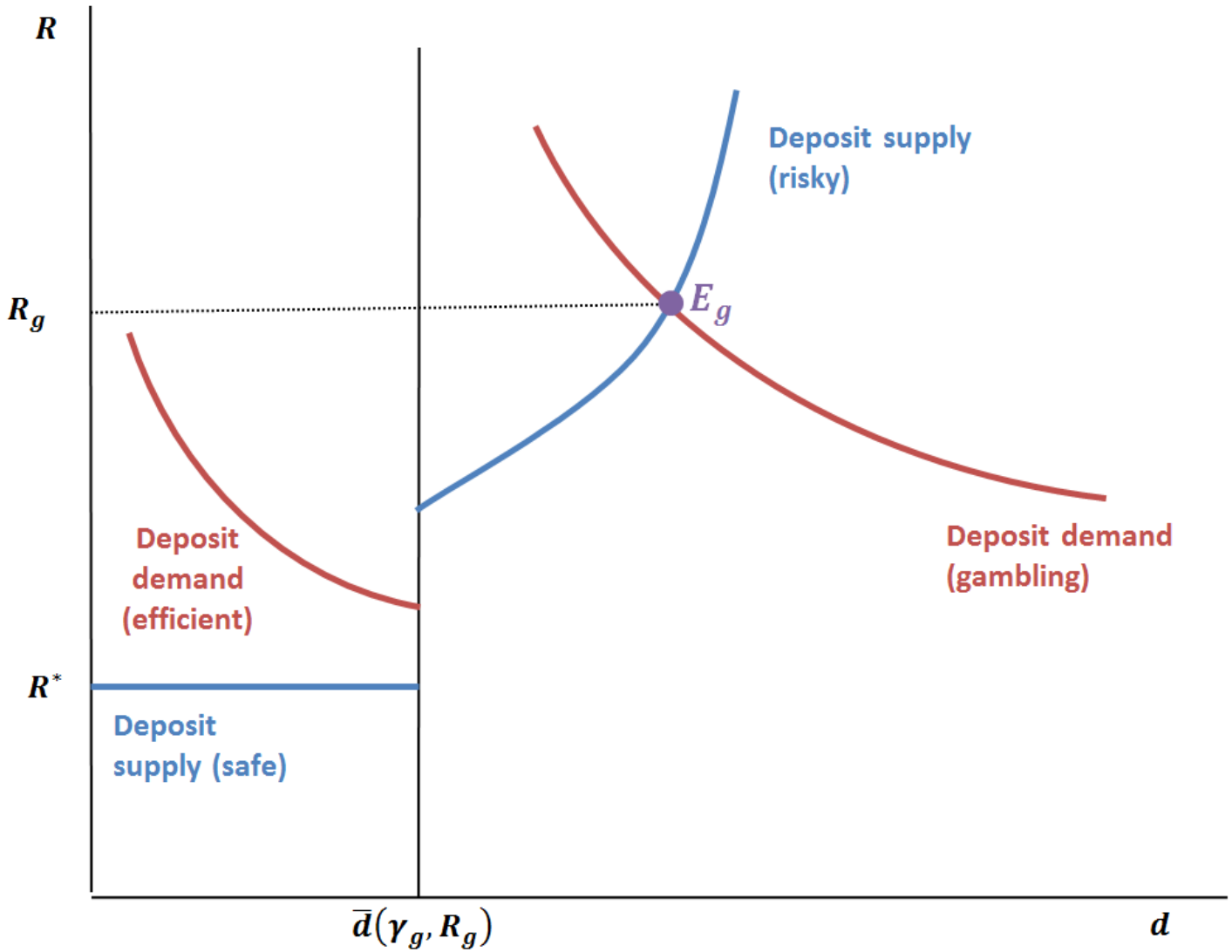
- First order conditions

$$R^{G,H} = R_g + \mu_d(D_g)$$
$$R_g^K = R^{G,H} + \mu_k(K_g)$$

- Crowding out of working capital lending

$$R^{G,H} > R^* \longrightarrow \gamma_g > \gamma_e \longrightarrow K_g < K_e$$

Gambling Strategy

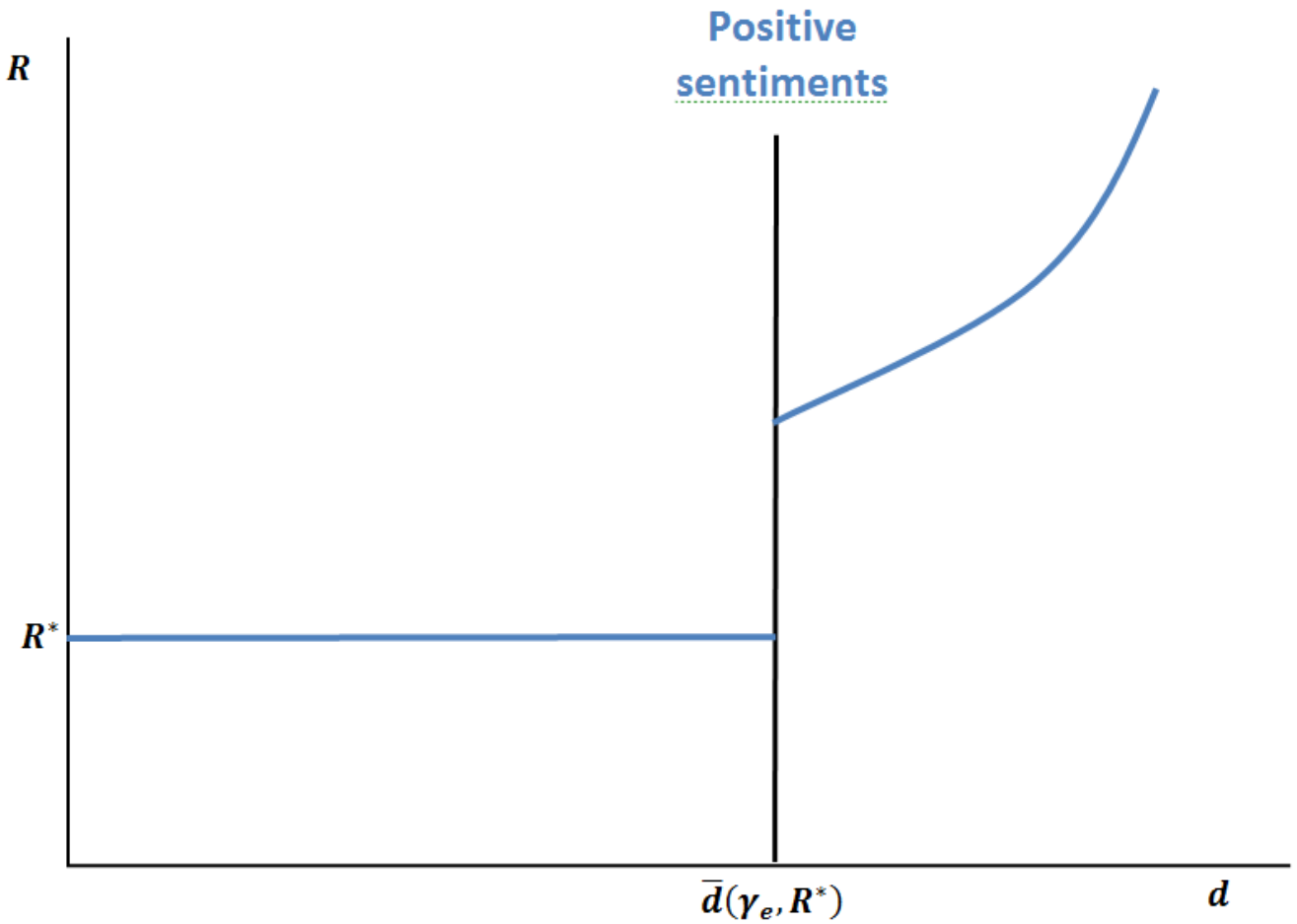


Where does multiplicity come from?

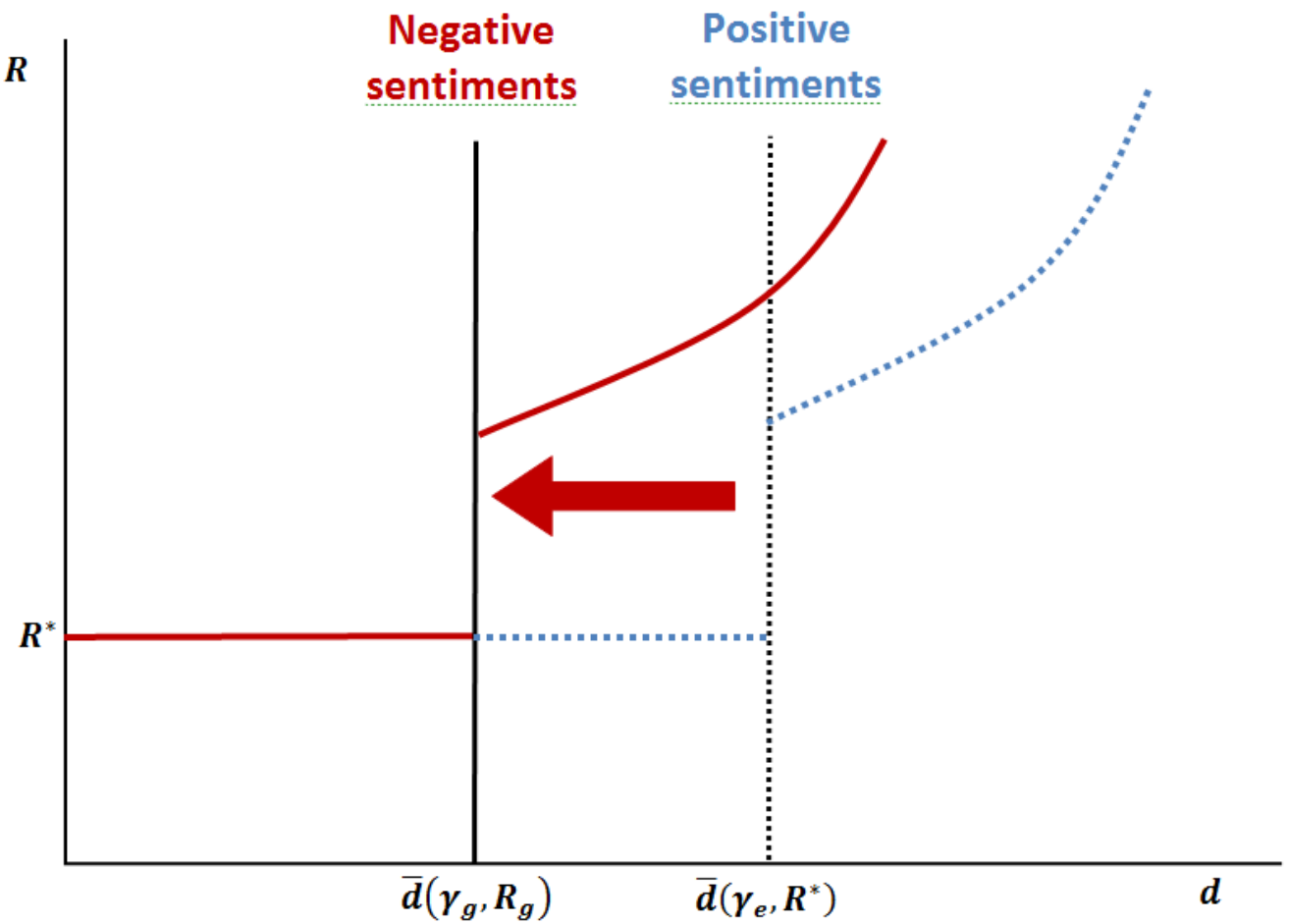
- Opaque bank balance sheets
  - Households can observe d but not γ
  - Banks cannot commit to γ
- Deposit threshold depends on household sentiments
  1. Positive sentiments: $\bar{d}(\gamma_e, R^*)$
  2. Negative sentiments: $\bar{d}(\gamma_g, R_g)$
- Rational expectations equilibrium:
  Sentiments must be confirmed in equilibrium

Sentiments

Negative sentiments tighten deposit threshold

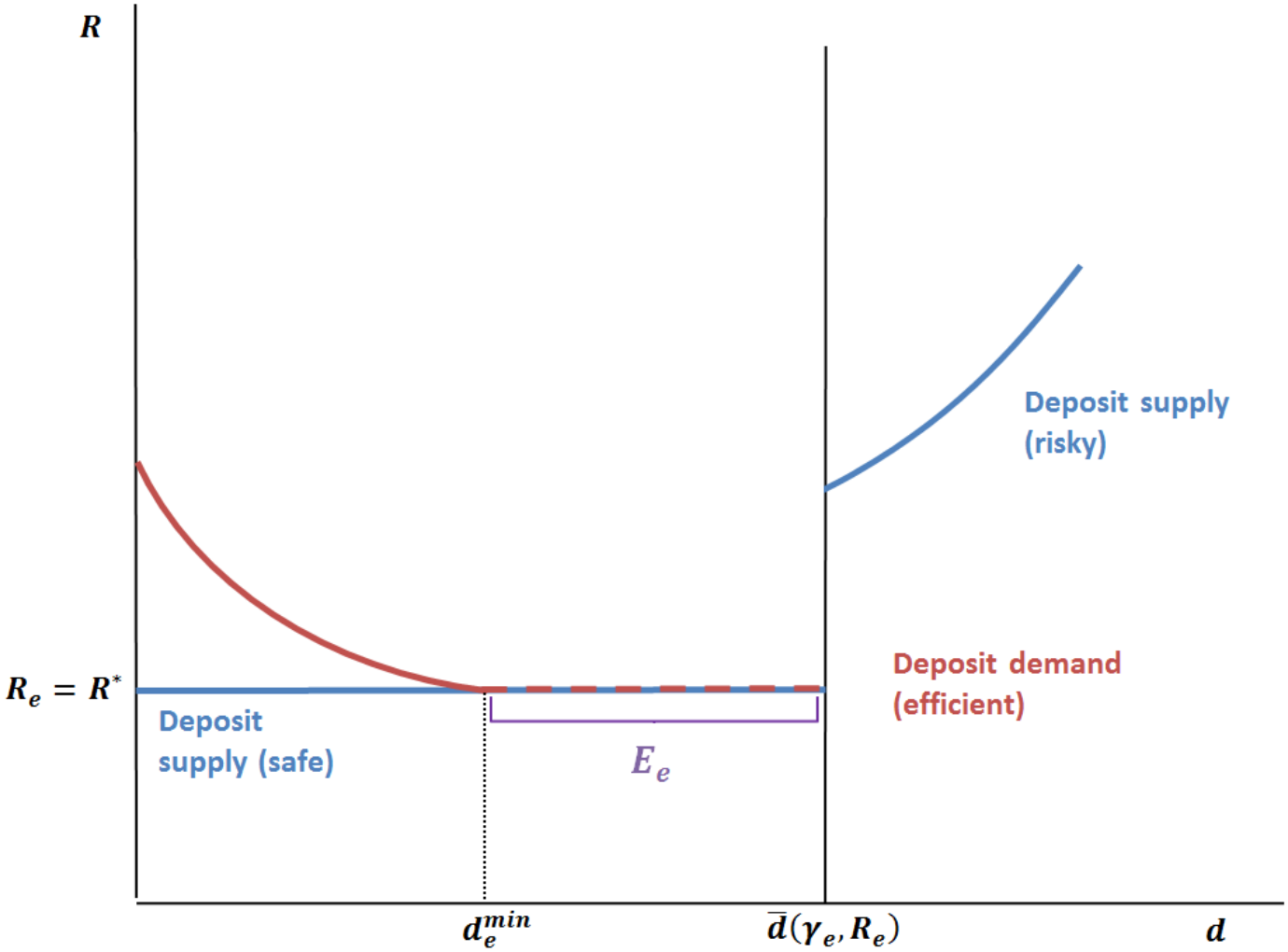


Negative sentiments tighten deposit threshold

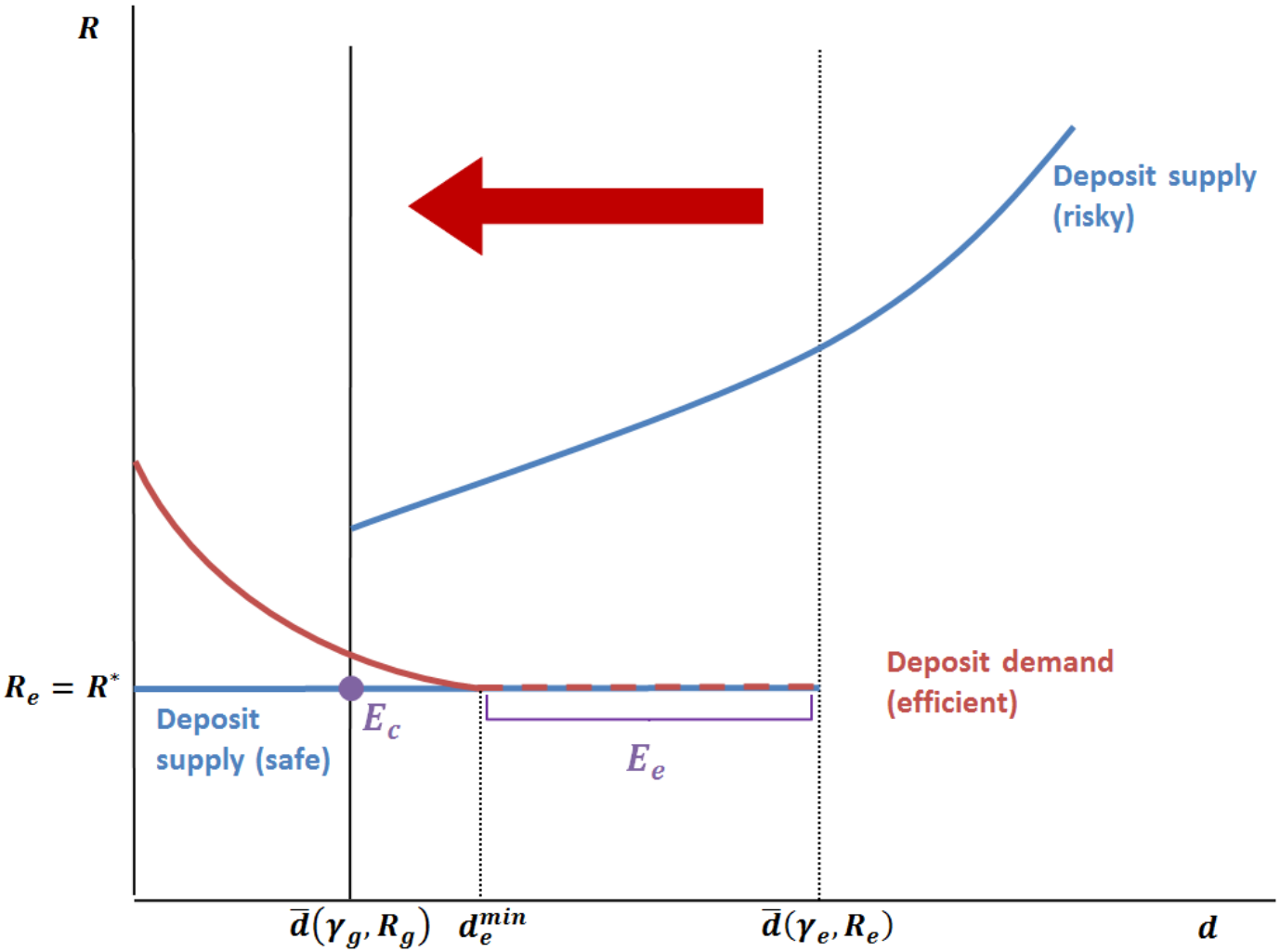


Multiplicity

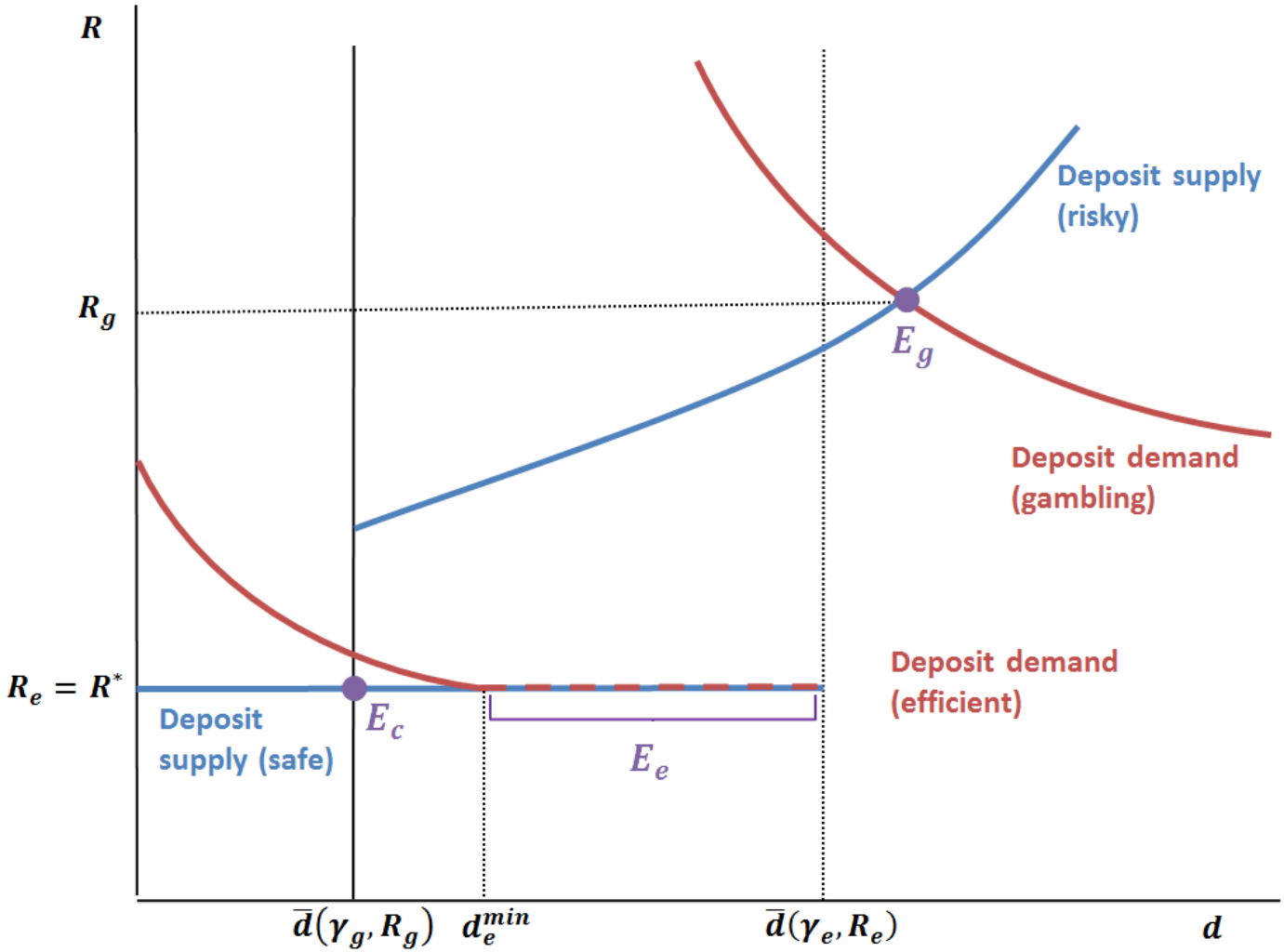
Positive sentiments: unconstrained, efficient strategy preferred



Negative sentiments: deposit constraint binds



Negative sentiments: deviate to gambling, sentiments confirmed



1. Efficient strategy preferred when unconstrained

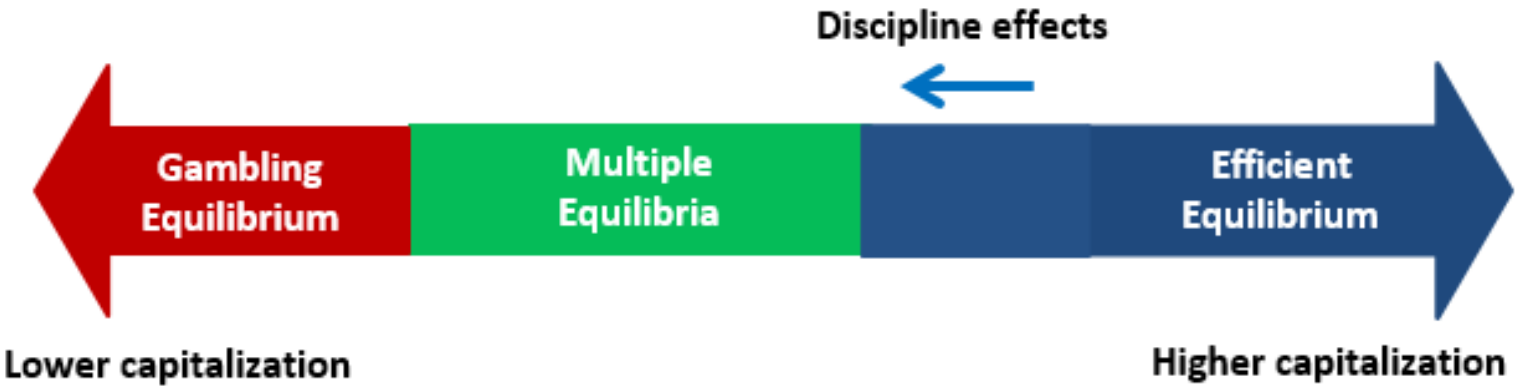
$$E\left[\hat{\Pi}_e\right] \geq E\left[\hat{\Pi}_{g|e}\right]$$

2. Deposit constrained under negative sentiment

$$d_e^{min} > \bar{d}\left(\gamma_g, R_g\right)$$

3. Gambling strategy preferred when constrained

$$E\left[\hat{\Pi}_c\right] < E\left[\hat{\Pi}_{g|c}\right]$$


Discipline effects
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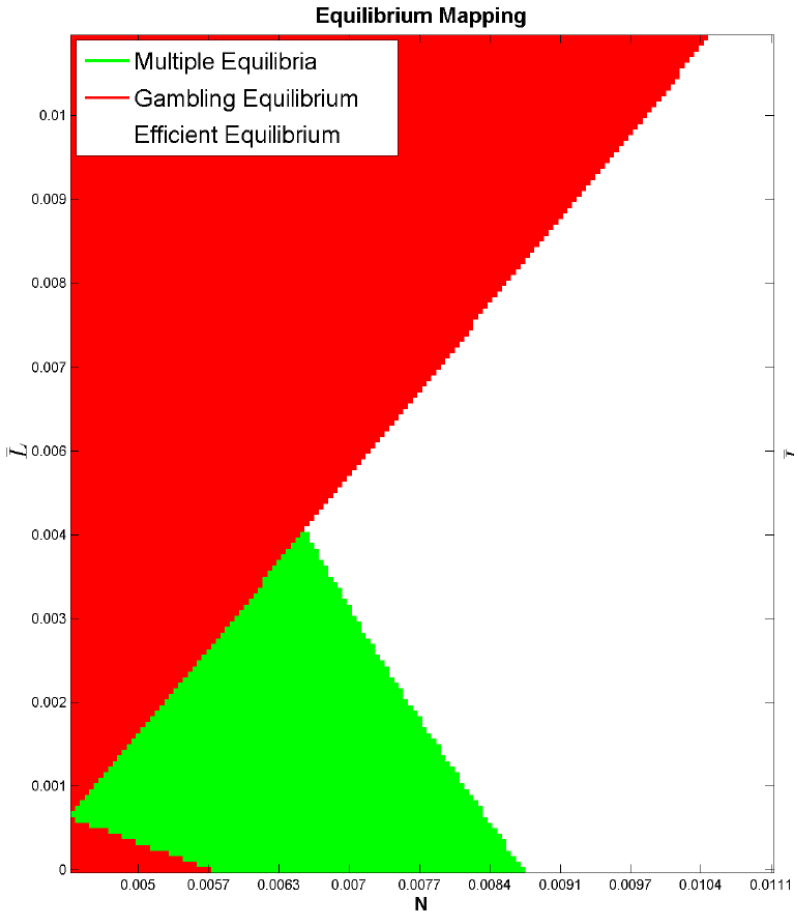
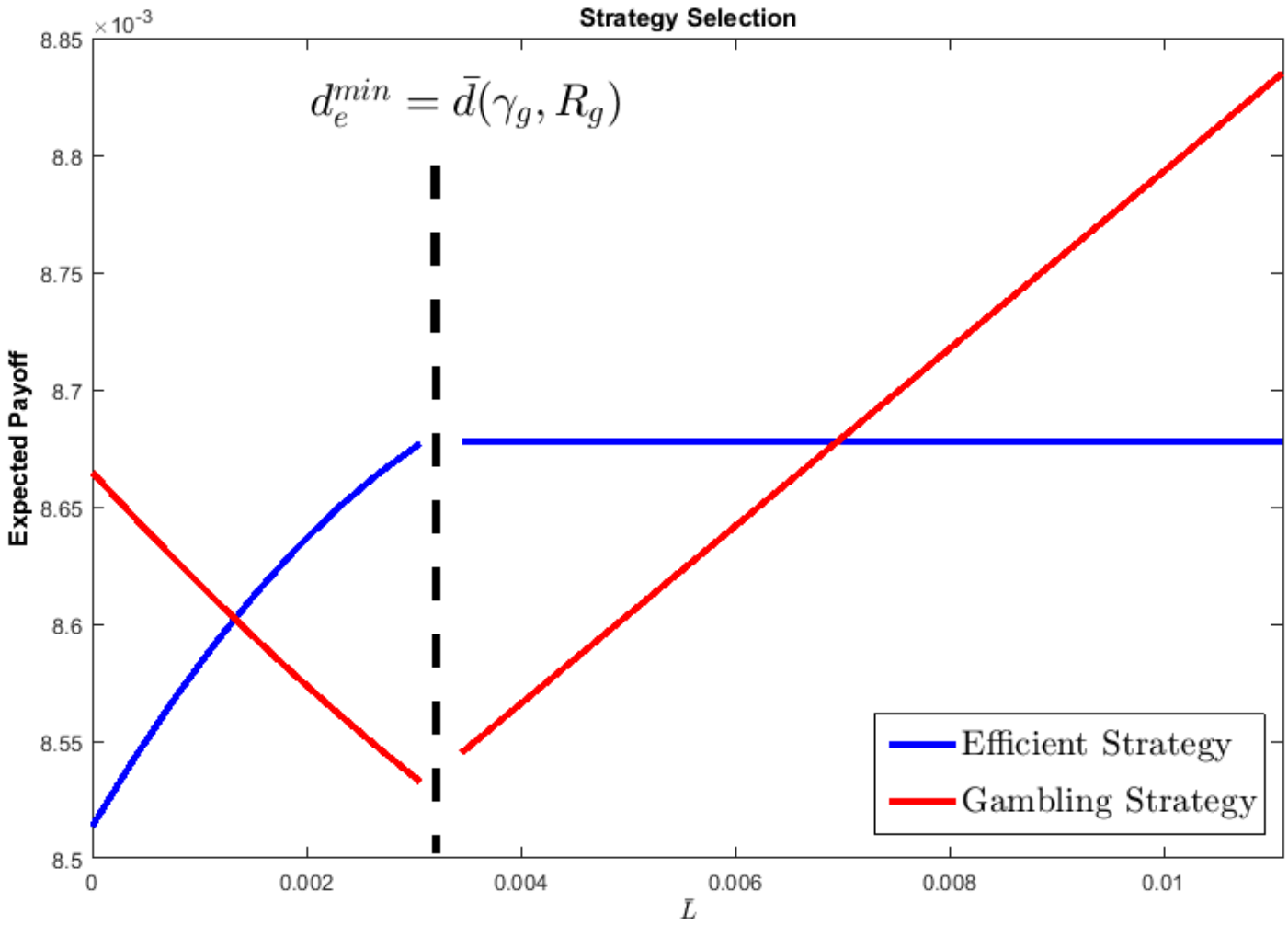
Policy Analysis: Liquidity Provision

- Similar to LTRO in stylized environment.
- Banks can borrow $\bar{L}$ from central bank at risk-free rate R^*.
- Trade-off: relieve constraint vs. incentivize gambling
- Intermediate $\bar{L}$ improves outcome, excessive eliminates eff. eq.

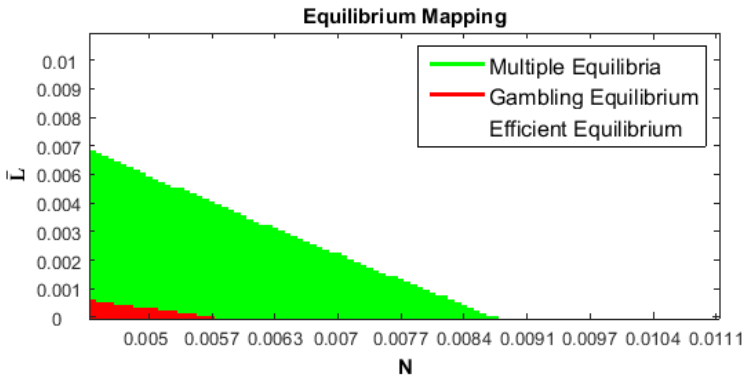


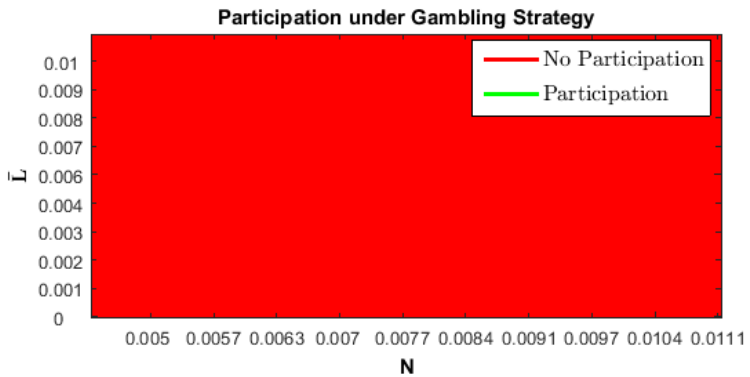
Policy Analysis: Liquidity Provision

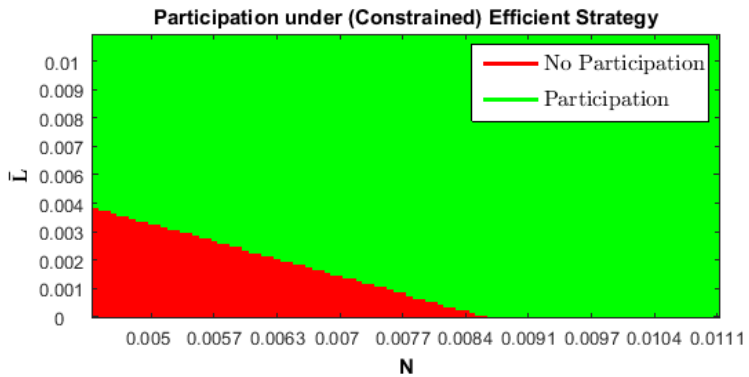


Policy Analysis: Targeted Liquidity Provision

- Similar to TLTRO in stylized environment.
- Lending conditionality $k \geqslant \bar{k}$
- Technology to discriminate between banking strategies
- Efficient equilibrium at all levels of capitalization

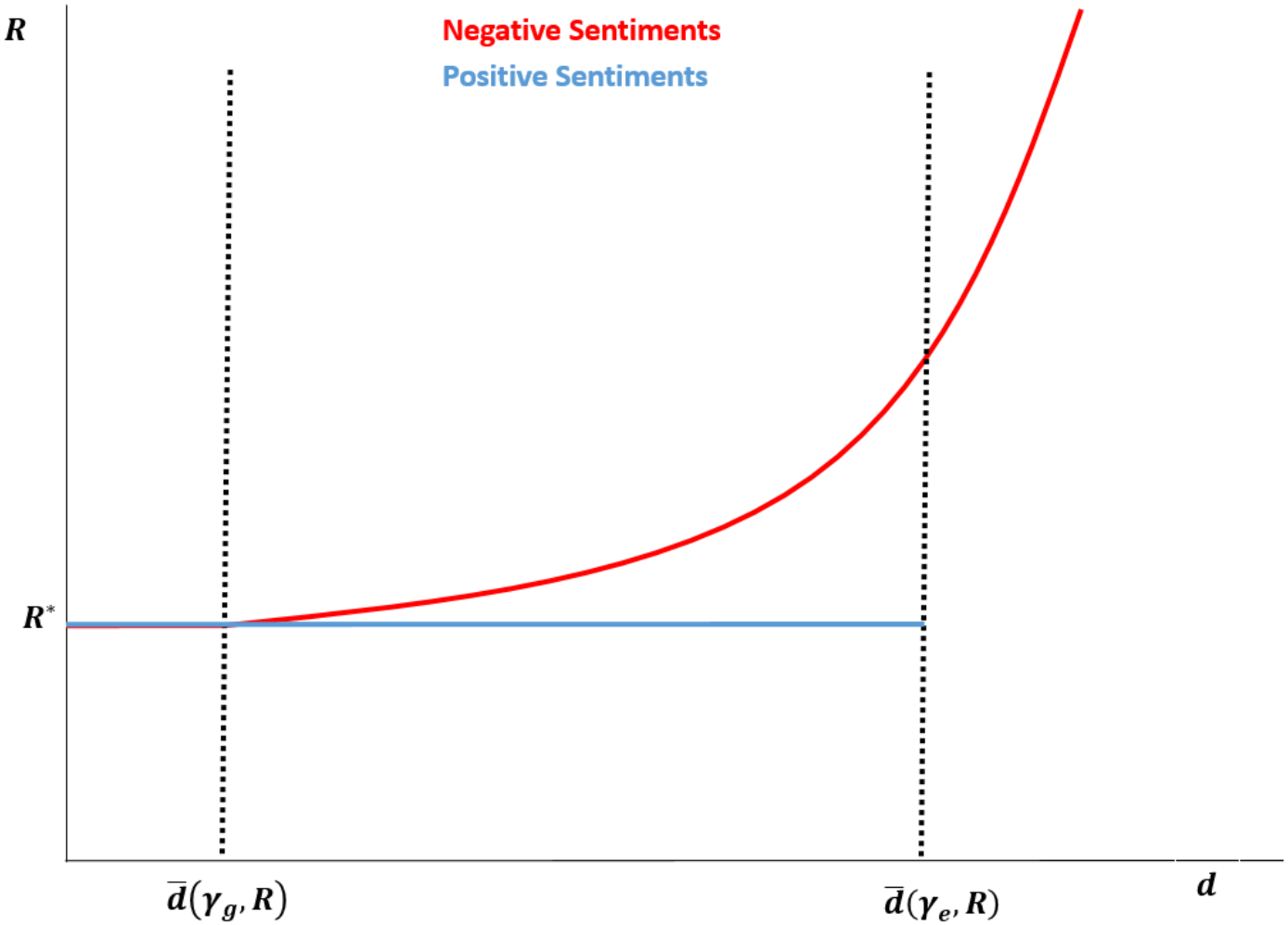






Relaxing assumptions (preliminary)

- Endogenous recovery rate after insolvency
- Haircut on depositors determined by shortfall in bank profits



Relaxing assumptions (preliminary)

Results remain valid with

- Non-bond cost T after sovereign default
  replaced with risky returns from working capital
  (driven by productivity decline after sovereign default)

Core assumptions for multiplicity

- Limited liability
- Non-transparent bank balance sheet
- Aggregate risk correlated with sovereign default

Dynamic model (preliminary)

- Steady state after sovereign default
- Banks consume portion $(1-\psi)$ of net worth when solvent

$$n' = \psi\pi$$

- 3 state variables under risk neutrality $S = \{n, N, \xi\}$

$$V(S) = \max_{d,\gamma} P[(1-\psi)max(\underline{\pi}, 0) + \psi \underline{V}(max(\underline{\pi}, 0))]$$
$$+ (1-P)\left[(1-\psi)\pi + \psi E\left\{V\left(S'\right)\right\}\right]$$

- Region of multiplicity is endogenous

$$M(S, x(S))$$

Computation

Decentralized, double iteration

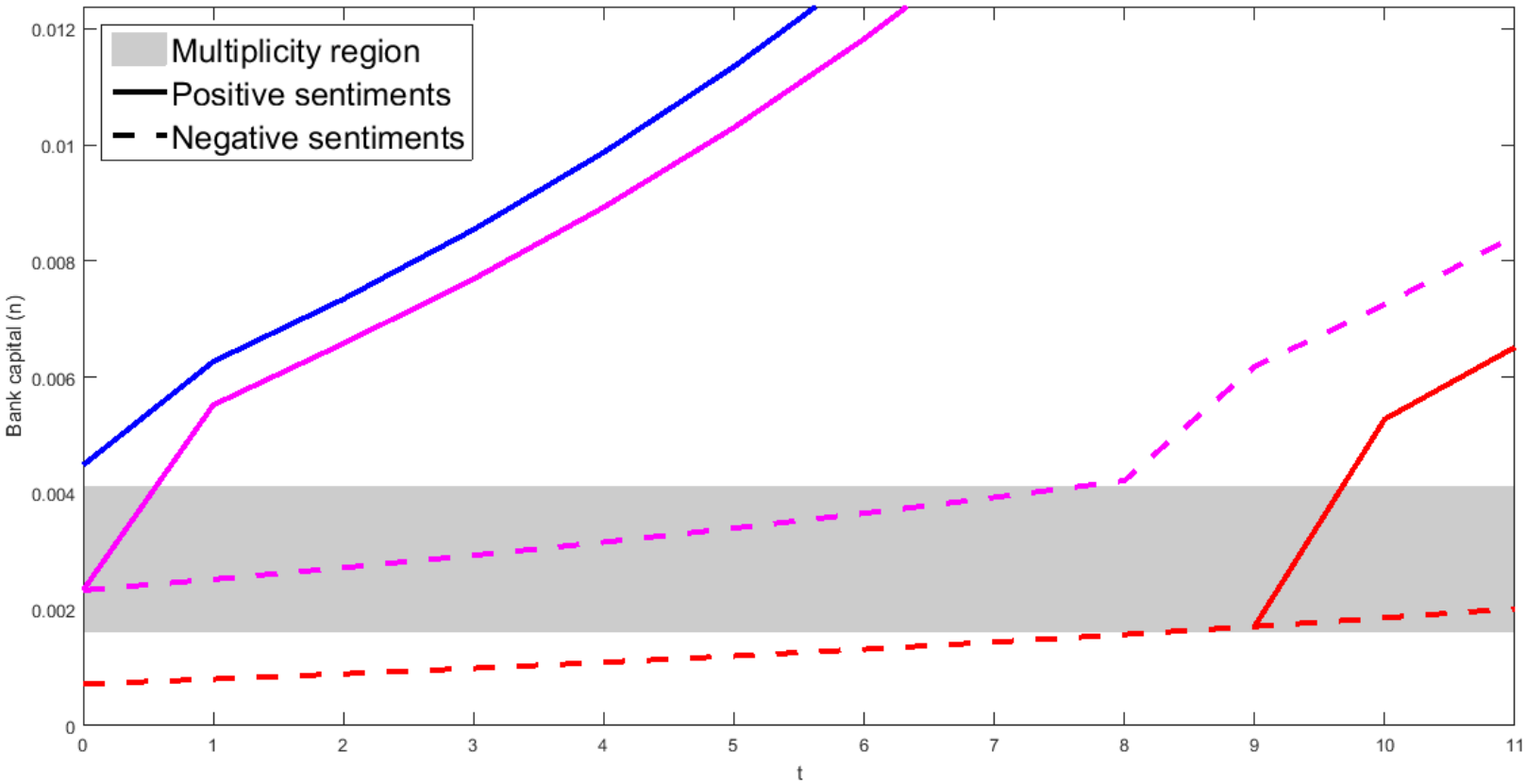
1. Guess $x(S)$ to get $M(S, x(S))$, law of motion $N' = \Gamma(S, x(S))$
2. Guess $V_0 = E\{V(S')\}$. Solve individual bank's problem.
3. V_0 updated according to guess in (1)
4. When V_0 converges, update (1)

Difficulty: $x(S)$ is discontinuous due to deviation to gambling

$$P\left[(1-\psi)+\psi\frac{d\underline{V}\left(max\left(\underline{\pi},0\right)\right)}{d\underline{\pi}}\right]\frac{d\underline{\pi}}{dx} =$$
$$-(1-P)\left[(1-\psi)+\psi\frac{dE\{V(S')\}}{d\pi}\right]\frac{d\pi}{dx}$$

Gambling Traps

- Rise in funding costs delays bank capital recovery *even when the gamble is successful*
- Bad sentiments: economy may spend a long time in multiplicity region



Conclusion

Main lessons

- Interactions between optimizing banks & depositors can lead to multiplicity
- Dynamically, gambling hinders bank capital recovery
- Policy trade-off: alleviate funding constraints vs incentivize gambling
- Policy design should distinguish between banking strategies

Next steps:

- Policy analysis in dynamic framework
- Endogenous sovereign default

THANK YOU!