

Comments by Rafael Repullo on

Endogenous Systemic Liquidity Risk

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Purpose of paper

- Construct model of systemic liquidity risk
 - Not based on Diamond and Dybvig (1983)
 - Not based on Holmström and Tirole (1998)
 - Related to Bolton, Santos, and Scheinkman (2010)
- Discuss optimal policy
 - Lender of last resort (LOLR)
 - Liquidity regulation
 - Capital regulation
 - Narrow banking

Main results

- LOLR prevents inefficient liquidation
 - But induces banks to free ride on liquidity provision
 - Too much investment in illiquid assets
- Liquidity regulation + LOLR is second best optimal
 - Dominates capital regulation
 - Dominates narrow banking

Overview of discussion

- Model setup
- Main comments
 - Need proper definition of equilibrium
 - Need proper welfare criterion
- Review of equilibrium analysis
- Review of welfare analysis
- Comments on the modeling of liquidity risk

Part 1

Model setup

Model setup

- Three dates ($t = 0, 1, 2$) – later on there will be a $t = \frac{1}{2}$
- Three types of risk-neutral agents
 - Investors with funds and no investment projects
 - Entrepreneurs with investment projects and no funds
 - Banks that channel funds from investors to entrepreneurs

Model setup

- Investors
 - Continuum with unit endowment at $t = 0$
 - Only want to consume at $t = 1$
 - No consumption shocks à la DD
 - Deposit funds in banks that offer deposit rate d

Model setup

- Entrepreneurs
 - Large number of entrepreneurs of two types
 - Type 1 have projects with return $R_1 > 1$ realized at $t = 1$
 - Type 2 have projects with return $R_2 > R_1$ realized at
 - either $t = 1$ (with *iid* probability p)
 - or at $t = 2$ (with *iid* probability $1 - p$)
 - Indifferent between consumption at $t = 1$ or $t = 2$
 - Borrow from banks at rates γR_1 or γR_2 (depending on type)
 - Keep $(1 - \gamma)R_1$ or $(1 - \gamma)R_2$

Model setup

- Banks
 - Large number that compete à la Bertrand at $t = 0$
 - Raise deposits from investors
 - Deposit rate d payable at $t = 1$
 - Grant loans to entrepreneurs
 - Loan rates γR_1 or γR_2 payable at either $t = 1$ or 2
 - Borrow at rate r in a market for liquidity at $t = 1$
 - Supplied by type 1 and early type 2 entrepreneurs

Model setup

- Model with no aggregate uncertainty
 - Proportion p of early type 2 projects is fixed
- Model with aggregate uncertainty
 - Proportion p can take two values: p_L or $p_H > p_L$
 - Uncertainty resolves at $t = 1/2$
 - Depositors may run on the banks at $t = 1/2$
 - Liquidation value $c < 1$

Part 2

Main comments

Comment 1: Definition of equilibrium

- There is no formal definition of equilibrium
 - This makes analysis difficult to follow
- Start with simple model with no aggregate uncertainty (fixed p)
- Equilibrium involves triple (α, d, r)
 - Banks' share α of investment in type 1 projects
 - Deposit rate d offered to investors
 - Interest rate r in market for liquidity

Comment 2: Welfare criterion

- There is no explicit welfare criterion
 - Except to avoid inefficient costly liquidation at $t = 1/2$
 - This complicates discussion of optimal policy

Part 3

Equilibrium analysis

Definition of equilibrium (fixed p)

- A symmetric equilibrium is triple (α, d, r) such that
 - Banks' revenue maximization

$$\max_{\alpha} \left[\alpha \gamma R_1 + (1 - \alpha) \left(p \gamma R_2 + \frac{(1 - p) \gamma R_2}{r} \right) \right]$$

Revenue from type 1

Revenue from early type 2

Revenue from late type 2 (discounted)

- Banks' zero profit: deposit rate d equals max. revenue
- Interest rate r clears market for liquidity

Characterization of equilibrium

- Two possible solutions
 - Corner solution: no investment in type 1 asset ($\alpha = 0$) if

$$R_1 < pR_2 + \frac{(1-p)R_2}{r}$$

- Interior solution: investment in both assets ($0 < \alpha < 1$) if

$$R_1 = pR_2 + \frac{(1-p)R_2}{r}$$

→ How is r determined?

Characterization of equilibrium

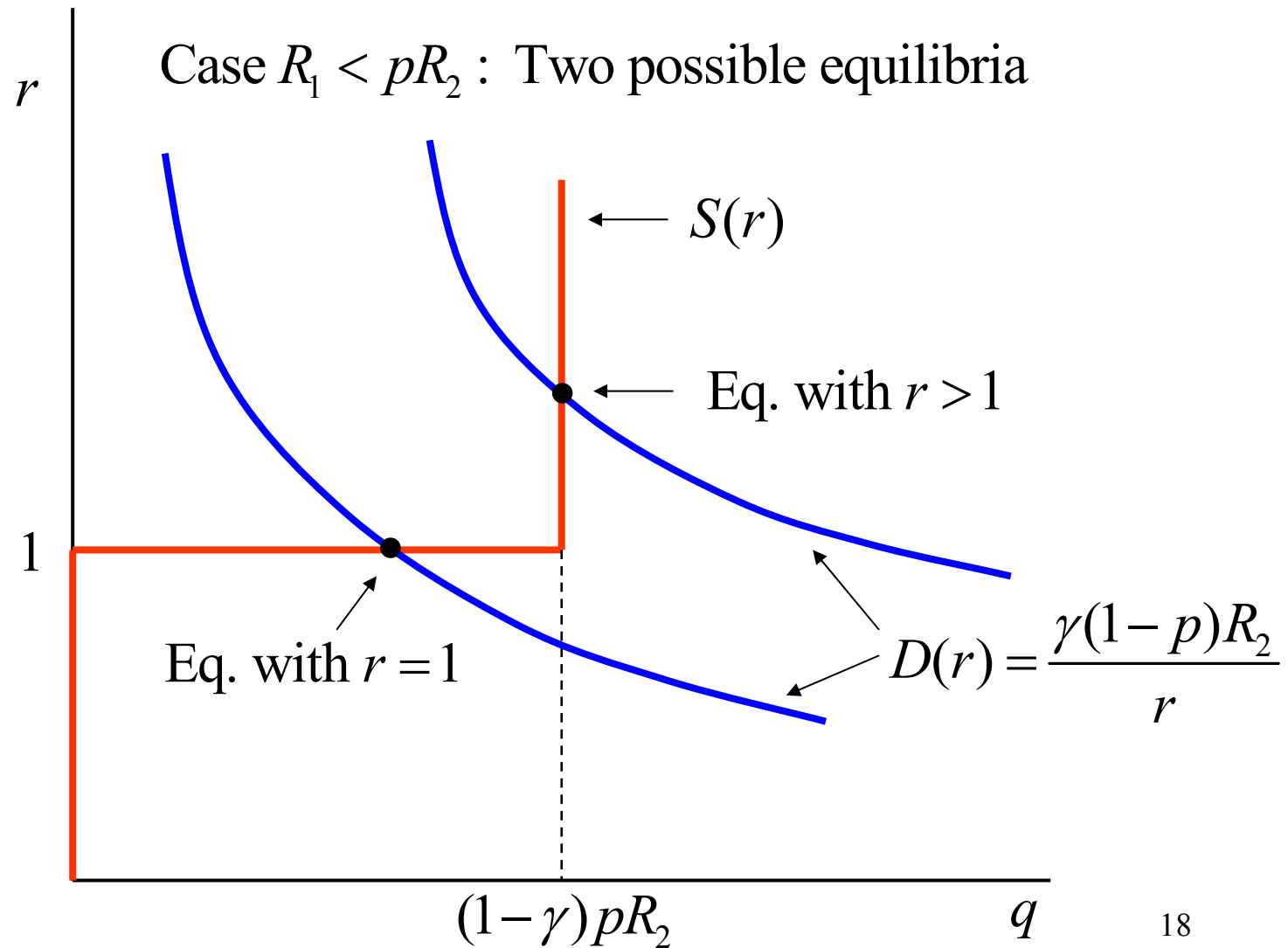
- Equilibrium in market for liquidity
 - Consider the simple case $R_1 < pR_2$
 - Banks only invest in type 2 projects ($\alpha = 0$)
 - Supply of liquidity (by early type 2 entrepreneurs)

$$S(r) = \begin{cases} (1 - \gamma)pR_2, & \text{if } r > 1 \\ 0, & \text{if } r < 1 \end{cases}$$

- Demand for liquidity (by banks)

$$D(r) = \frac{\gamma(1 - p)R_2}{r}$$

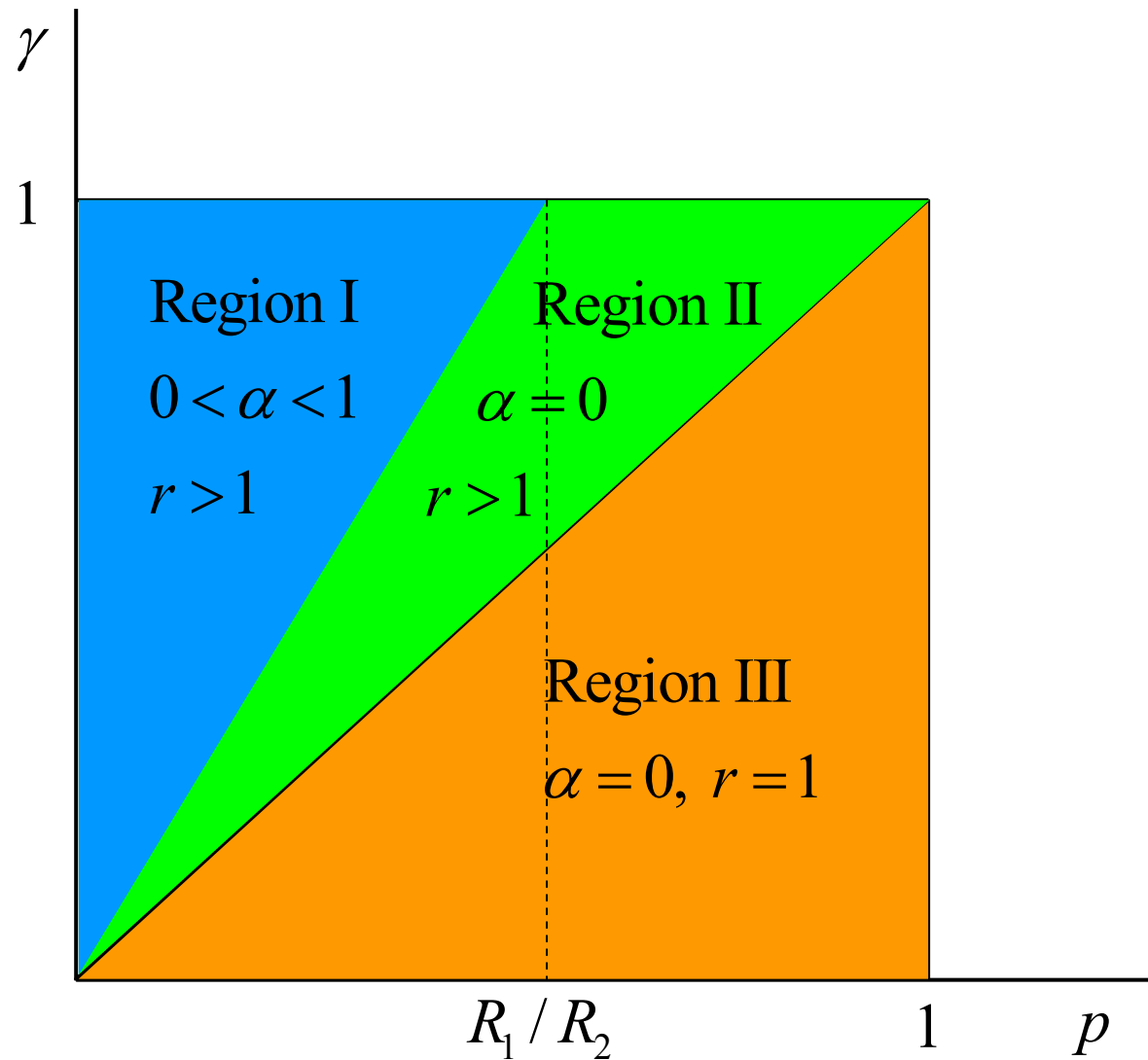
Characterization of equilibrium



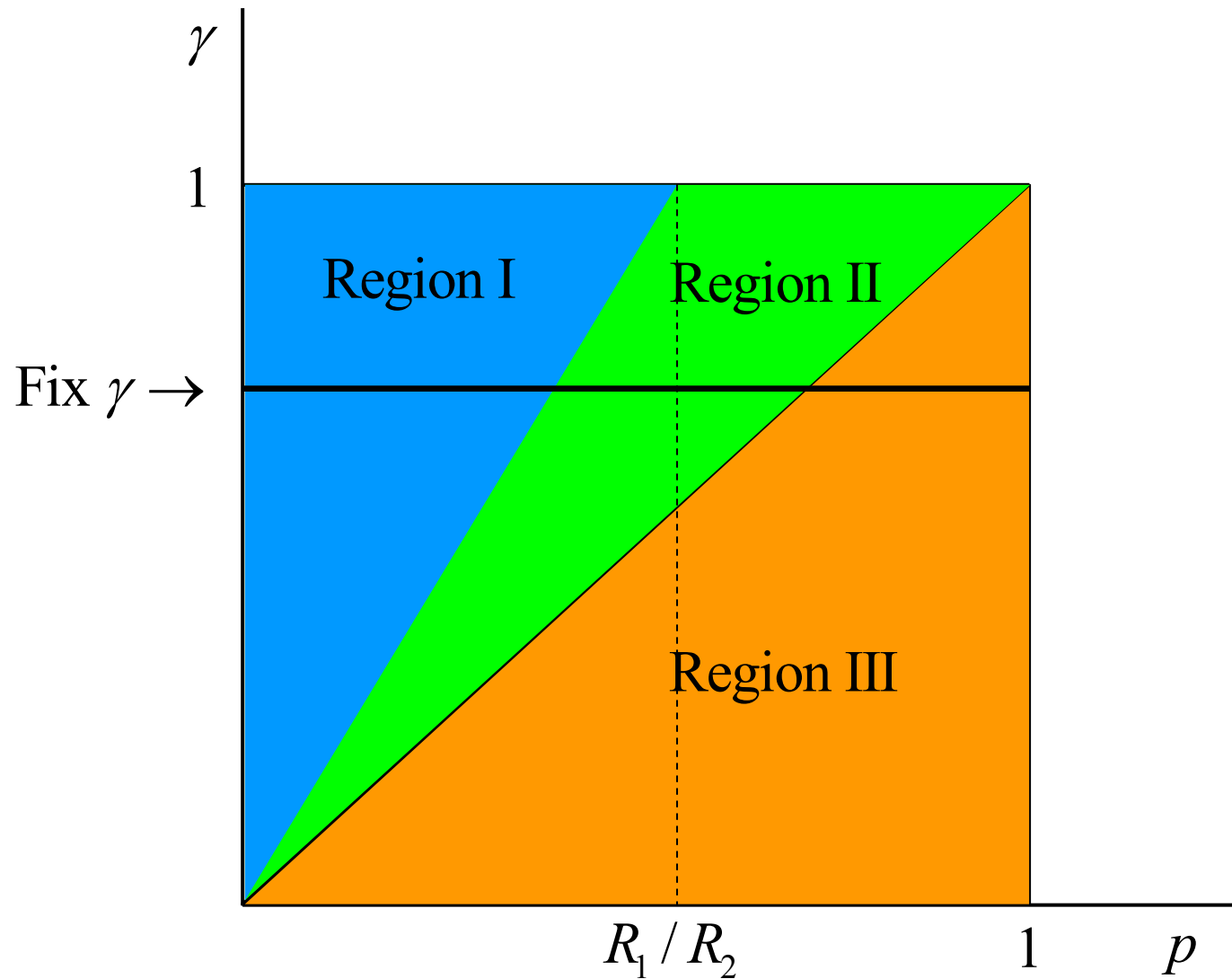
Characterization of equilibrium

- Three regions
 - Region I: $\gamma \geq pR_2/R_1$
 - Equilibrium: $0 < \alpha < 1$, $d = \gamma R_1$, $r > 1$
 - Region II: $p \leq \gamma \leq pR_2/R_1$
 - Equilibrium: $\alpha = 0$, $d = pR_2$, $r > 1$
 - Region III: $p \geq \gamma$
 - Equilibrium: $\alpha = 0$, $d = \gamma R_2$, $r = 1$

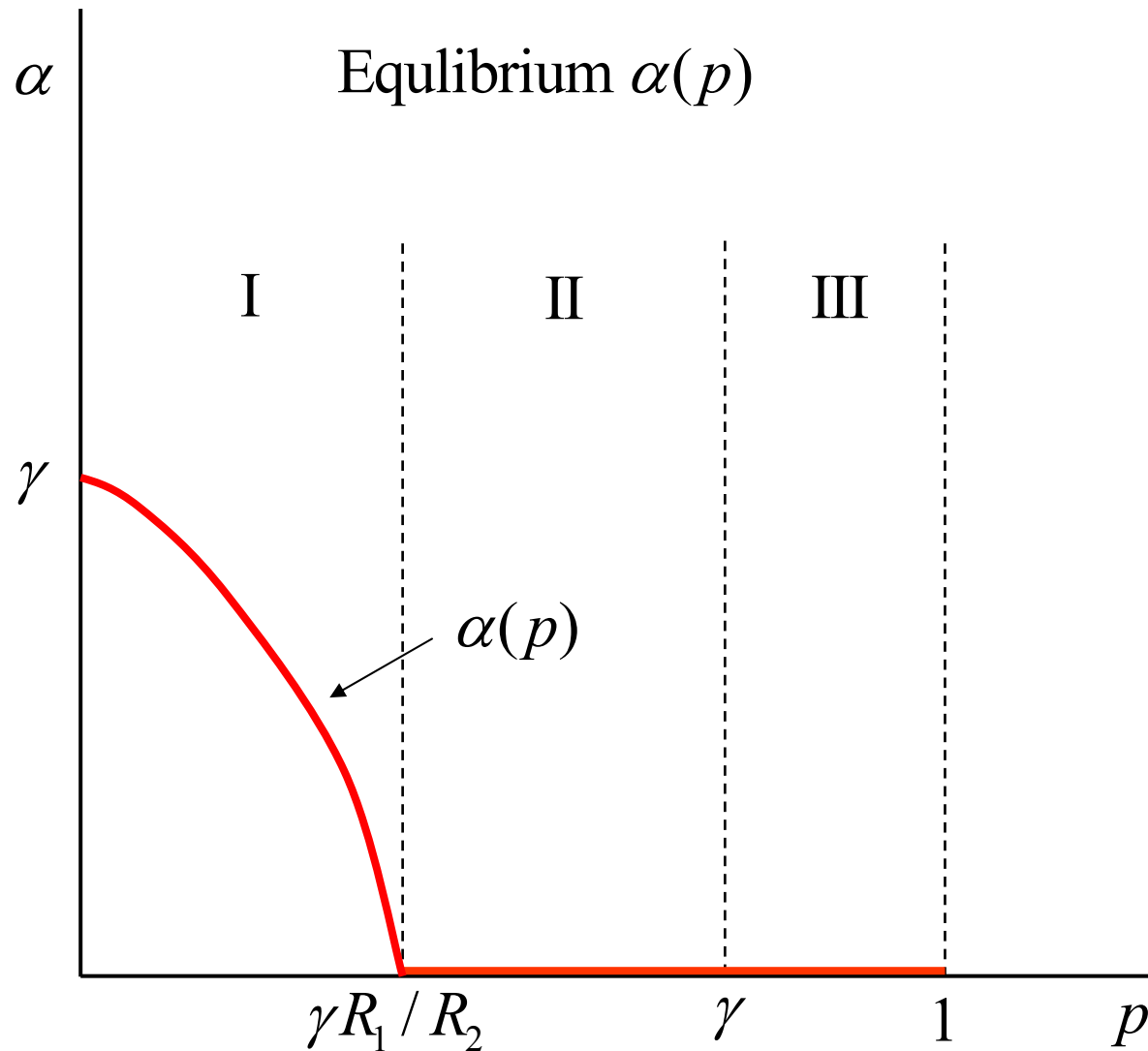
Characterization of equilibrium



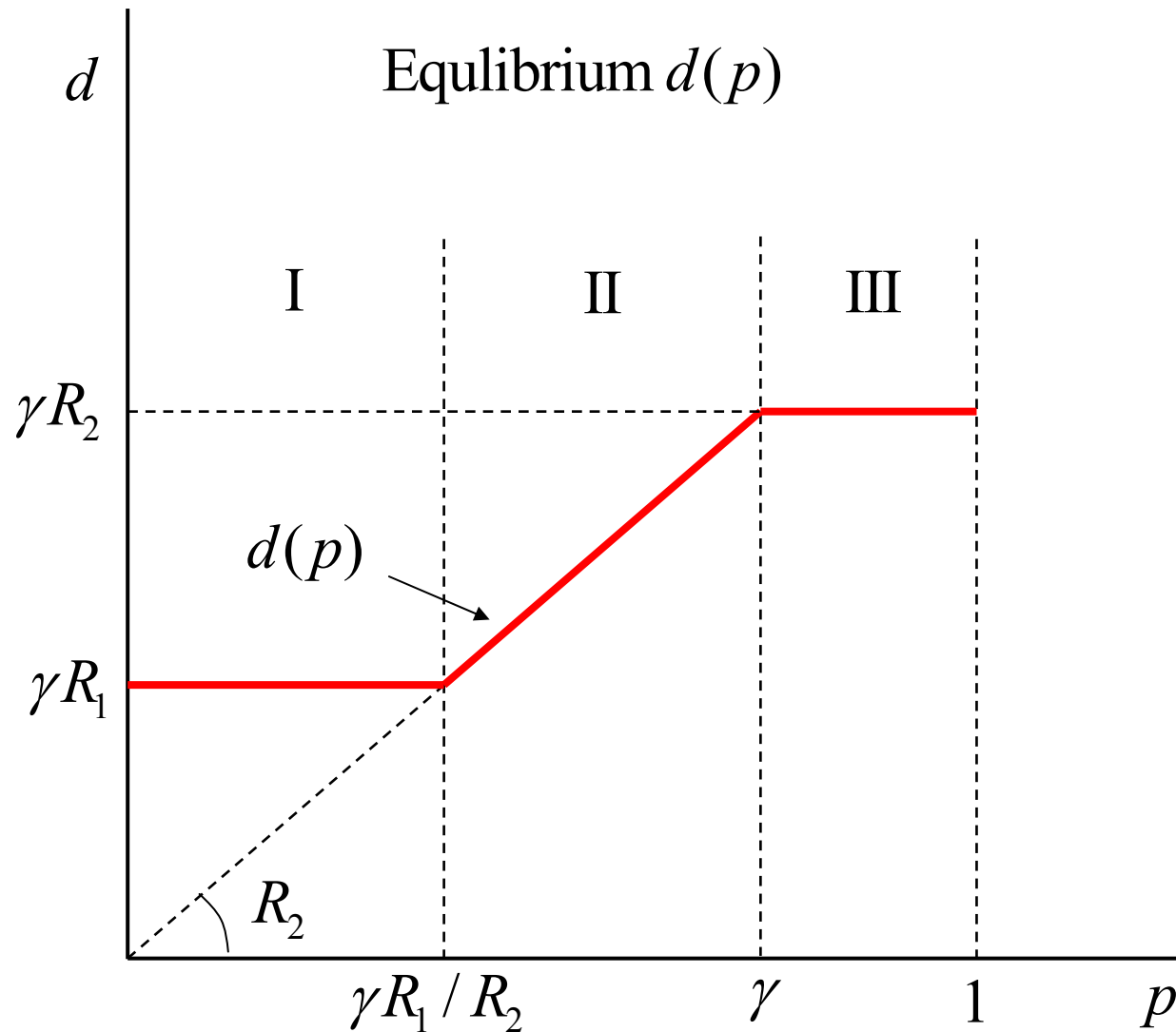
Characterization of equilibrium



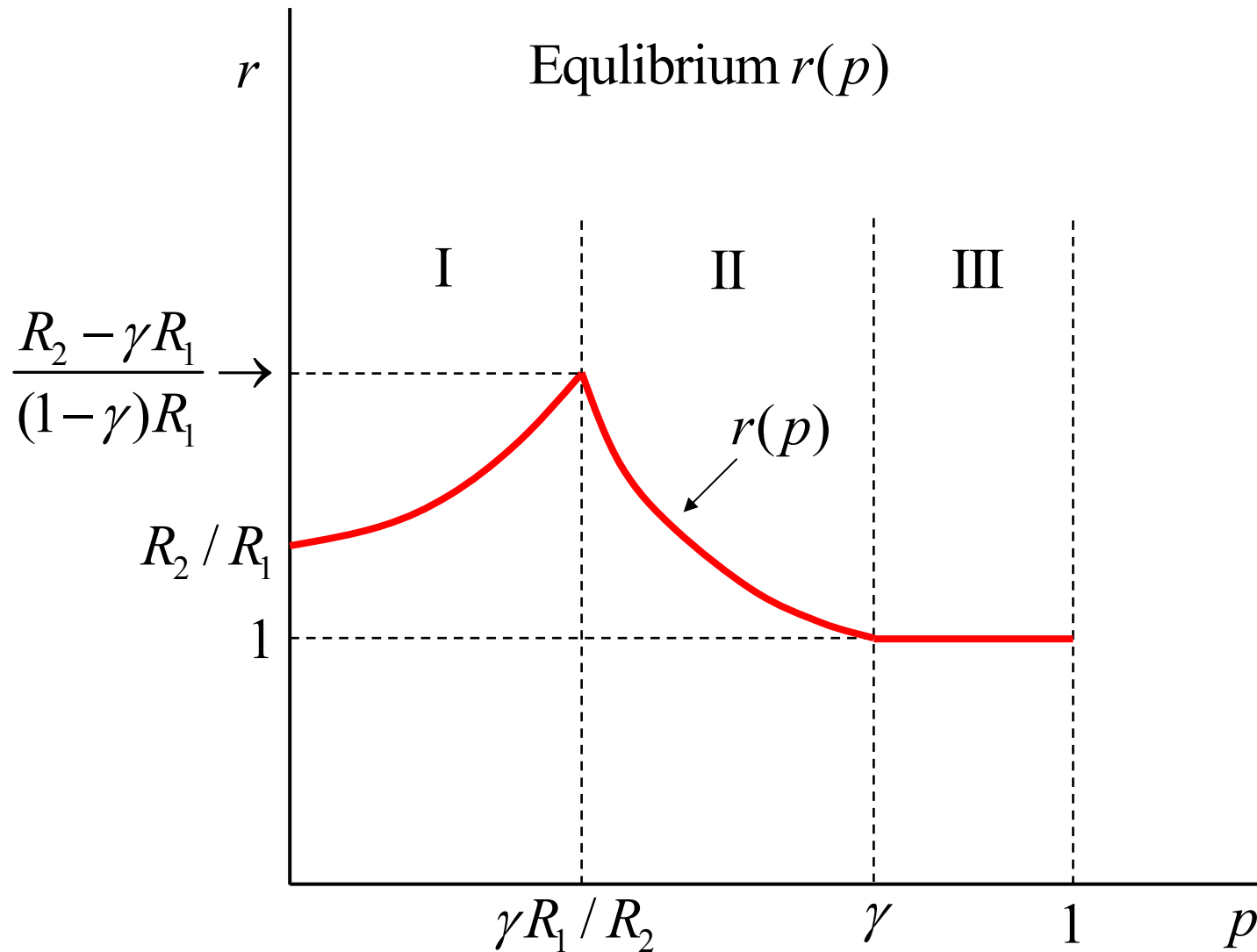
Characterization of equilibrium



Characterization of equilibrium



Characterization of equilibrium



The model with aggregate uncertainty

- Suppose that $p = \begin{cases} p_H & \text{with prob. } \pi \\ p_L & \text{with prob. } 1 - \pi \end{cases}$
- Suppose that both p_H and p_L are in Region I

→ By previous results

$$\alpha_L = \alpha(p_L) > \alpha(p_H) = \alpha_H$$

- If banks choose $\alpha = \alpha_L \rightarrow$ excess supply of liquidity in H
 - If banks choose $\alpha = \alpha_H \rightarrow$ excess demand for liquidity in L
- What is the equilibrium?

Characterization of equilibrium

- Fraction θ of banks set $\alpha = 1$ and always survive
 - Deposit rate $d_1 = \gamma R_1$
- Fraction $1 - \theta$ of banks set $\alpha = 0$ and fail in state L
 - Deposit rate d_0 such that
$$\pi d_0 + (1 - \pi)c = d_1$$
- Equilibrium θ is decreasing in π with $\lim_{\pi \rightarrow 0} \theta = 1$
 - If state L is very likely almost all banks survive

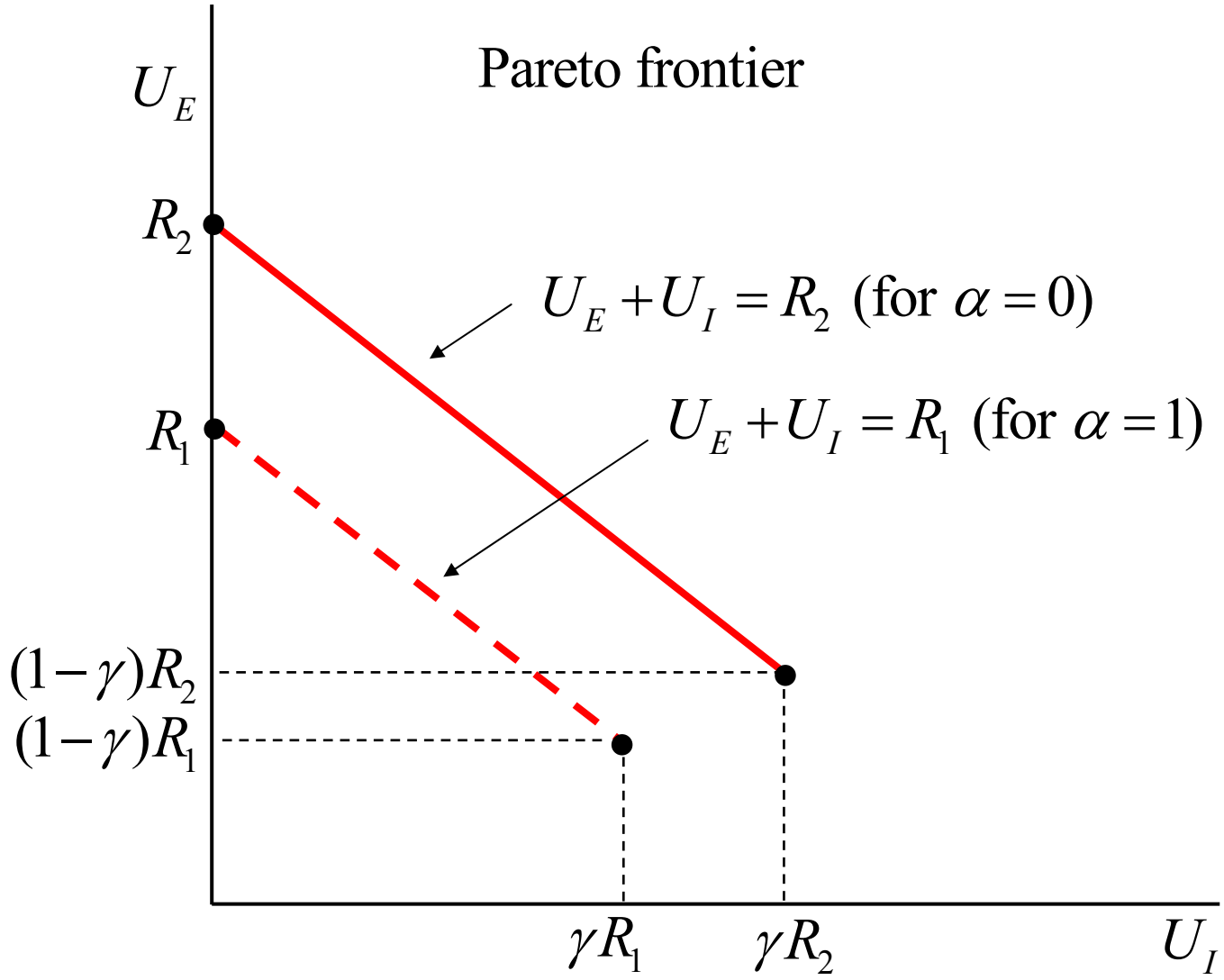
Part 4

Welfare analysis

Welfare analysis

- Consider a social planner that chooses
 - Share α of wealth invested in type 1 projects
 - Share δ of output at $t = 1$ given to investors
- Output at $t = 1$: $y_1 = \alpha R_1 + (1 - \alpha)pR_2$
- Output at $t = 2$: $y_2 = (1 - \alpha)(1 - p)R_2$
- Investors' utility: $U_I = \delta y_1$
- Entrepreneurs' utility: $U_E = (1 - \delta)y_1 + y_2$
 - Constraint: $U_E \geq (1 - \gamma)[\alpha R_1 + (1 - \alpha)R_2]$
 - Otherwise they would not work

Welfare analysis



Welfare analysis

- Investing everything in type 2 (illiquid) assets is efficient
 - Why may the market allocation be inefficient?
 - What are constraints associated with policy instruments?
 - Look at LOLR operations, liquidity requirements, etc.

Part 5

Modeling liquidity risk

Comments on the modeling liquidity risk

- General approach in literature
 - Liquidity shock that involves shortage of real resources
 - Early consumption that requires current output
 - Intermediaries with no capital: focus on **market liquidity**
- What would be desirable
 - Liquidity shocks involving portfolio reallocations
 - From one asset to another asset
 - Intermediaries with capital: focus on **funding liquidity**

Comments on the modeling liquidity risk

- Two types of models of liquidity risk
 - Models with real (consumption or production) shocks
 - Models with reallocation (of financial claims) shocks
- Central banks can create liquidity “at the drop of a hat”
 - This works in models with reallocation shocks
 - But does not work in models with real shocks
 - Central banks cannot produce more output
 - Central banks can reduce value of nominal claims
 - This is what LOLR does in the paper

Comments on the modeling liquidity risk

- Need models of reallocation shocks
 - Related to solvency concerns → information-based runs
 - Role of funding liquidity (ability to borrow)
 - Role of bank capital
- My (relatively uninformed) guess is that in such models
 - Liquidity requirements would probably be suboptimal
 - Penalize investments with higher expected returns
 - Capital charges for liquidity risk could be better

Concluding remark

- Paper constructs model of systemic liquidity risk
 - Interesting novel setup
 - Liquidity shocks are exogenous
 - Supply of liquidity is endogenous (as in extant literature)
 - Not really model of “endogenous” systemic liquidity risk
- More work needs to be done
 - Characterization of equilibrium
 - Policy analysis