Bailouts, Moral Hazard, and Banks' Home Bias for Sovereign Debt

Gaetano Gaballo
Banque de France & ECB

Ariel Zetlin-Jones
CMU - Tepper

September 23, 2016

FRB St. Louis Innovations in Central Banking Conference

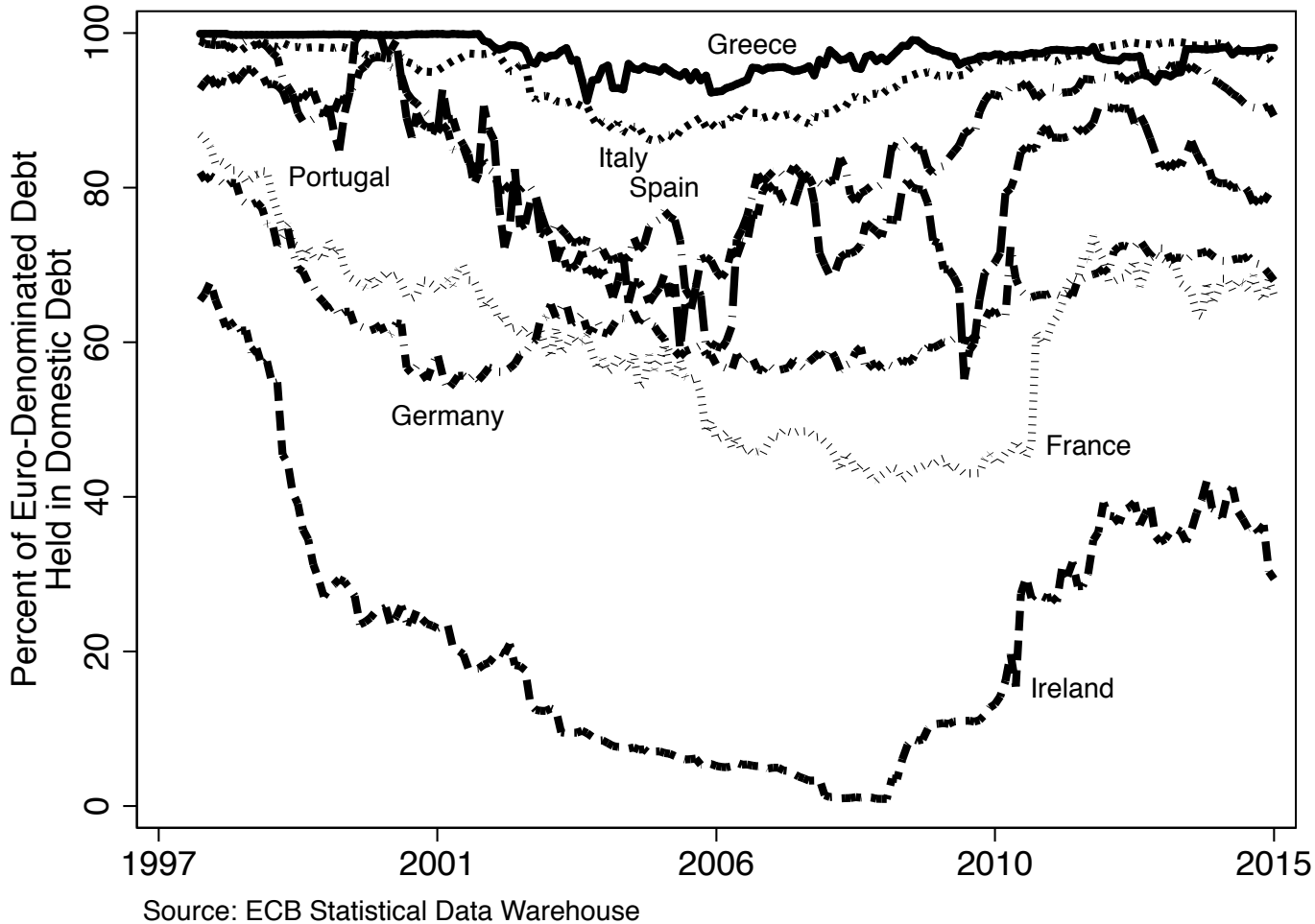
Motivation

- Well documented evidence of banks' *home bias* for sovereign debt
  - Euro-Zone: $\approx$ 80% of €-Sovereign Debt is home Sovereign debt
  - No clear regulatory (Basel, ECB) incentive for home bias
  - May have expected greater diversification

- Home bias contributing to policy concerns:
  - "Diabolic Loop"
  - EZ financial segmentation

Motivation

- Evidence of banks' *home bias* for sovereign debt



Source: ECB Statistical Data Warehouse

  - *Home Bias Measure:* Ratio of domestic Sovereign debt relative to euro-denominated Sovereign debt held by domestic banks

This Paper

- Study interaction between home bias and Gov't Bailout policy
- Key Findings:
  - Banks' home bias limits effectiveness of bailouts
    - Assumes gov't debt prices elastic to unexp. debt issues
  - Home bias a mechanism for Depositors to discipline Gov't Bailouts
    - Home bias deters goverment bailouts, which otherwise induce moral hazard in financial sector
    - Home bias both *privately* and socially valuable

A *Market* Mechanism

- Government faces time inconsistency problem vis-à-vis bailouts
  - Bailouts improve outcomes ex post
  - Expectations of bailouts cause moral hazard in financial sector
- Home Bias is a private sector response to deter bailouts
  - Bailouts financed with new debt issues
  - Gov't debt prices sensitive to size of bailout
  - **Critical Trade-Off**: Public capital injections cause bank capital losses via depreciation of public debt (endogenous re-negotiation cost)
  - Home bias resolves gov't time inconsistency problem (at cost)

Additional Findings

- Positive Implications: On the evolution of home bias
  - Decrease in "bailout capacity" implies decrease in home bias
  - Is an increase in Sovereign credit risk $\equiv$ decrease in bailout capacity?
    - Show relationship more subtle
  - Model capable of generating salient patterns of home bias

- Normative Implications: a bailout authority should issue debt
  - Should Eurobonds be part of the European Stability Mechanism?
  - Home bias for Eurobonds may limit Euro area bailout capacity
  - Improved financial intermediation, but *less* resilient financial system

Related Literature

- Financial Intermediation, Liquidations as Disciplining Device
  - Holmstrom and Tirole (1998), Calomiris and Kahn (1991), Diamond and Rajan (2001)

- Bailouts, Time Inconsistency, and Home Bias
  - Chari and Kehoe (2013), Chari, Dovis, and Kehoe (2014), Uhlig (2013), Farhi and Tirole (2015)

- Evidence on Home Bias and Bailouts
  - Bailouts costly for Governments
    - Acharya et al (2014)
  - Risk of Sovereign Default costly for banks
    - Gennaioli et al (2014)
  - Correlation between Financial and Sovereign Risk
    - Battistini et al (2013), Gilchrist and Mojon (2014), Acharya and Steffen (2013)

Benchmark Environment without Government Intervention

Environment

- 3 periods: $t = 0, 1, 2$
- 2 Agents
  - *Lender*: represents household depositors
  - *Bank*: represents aggregate financial sector
  - Preferences: $c_0 + c_1 + c_2$
- Bank protected by *limited liability* ($c_t \geq 0$)
- Bank endowed with A units of period 0 numeraire

Period 0 Investment Technologies

- *Public* debt: hI
  - Implicit period 1 or 2 rate of return R^S
- *Private* investment: $(1-h)I$
  - Yields stochastic returns in period 2
  - Requires additional financing or liquidity needs in period 1
  - Subject to two instances of moral hazard:
    - Bank's period 1 effort impacts distribution of liquidity needs
    - Bank's period 2 effort impacts distribution of returns
    - Low effort yields private bank benefit $B(1-h)I$ with $B > 0$

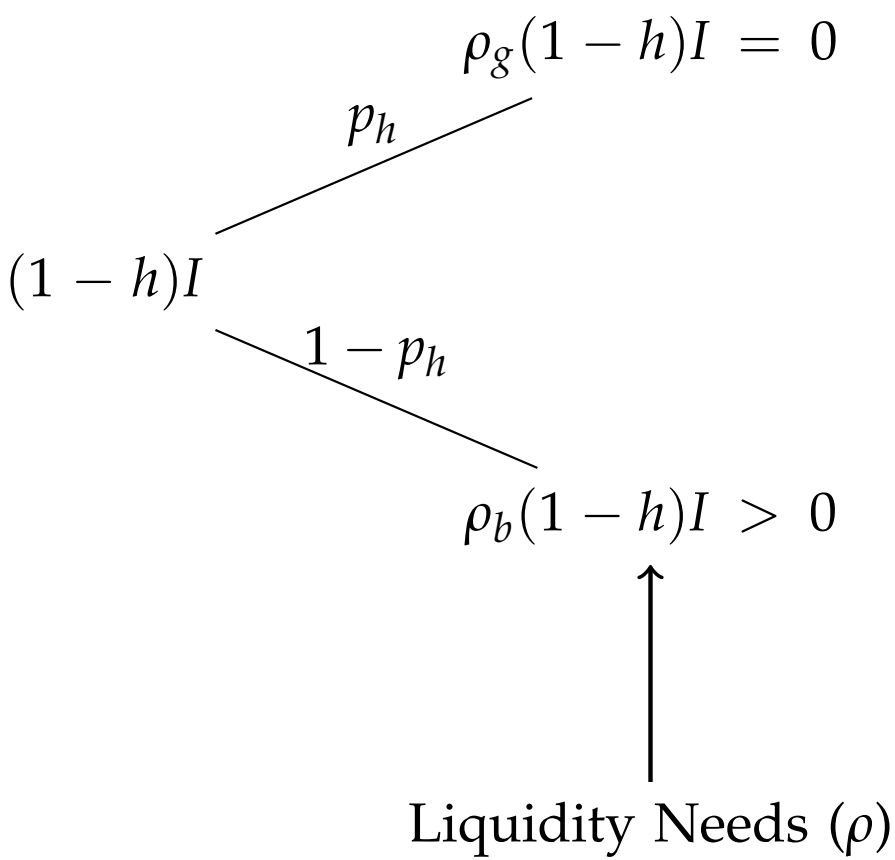
Private Investment Technology

Period 0 Period 1 Period 2

Private Investment Technology

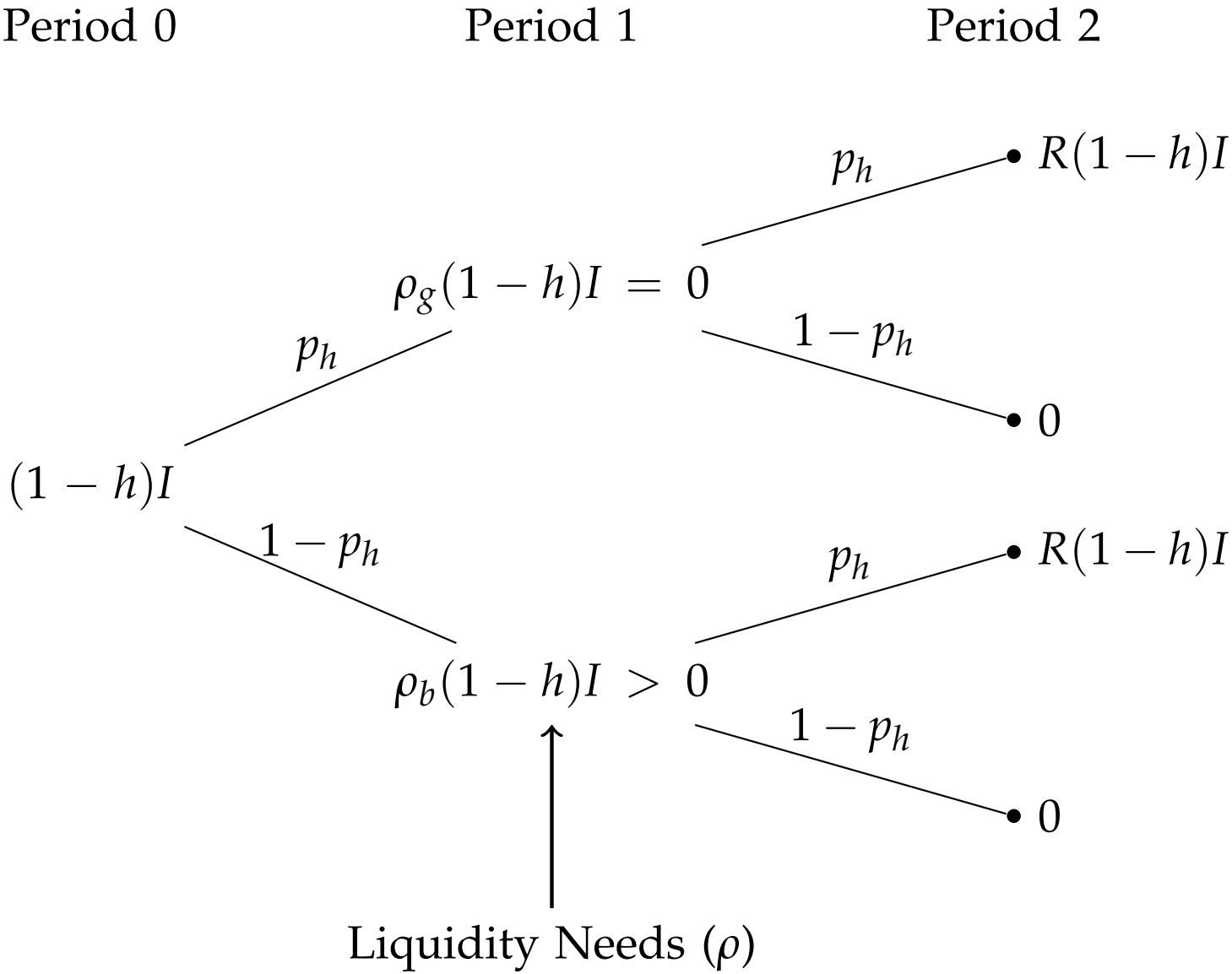
Period 0	Period 1	Period 2
$(1-h)I$		

Private Investment Technology



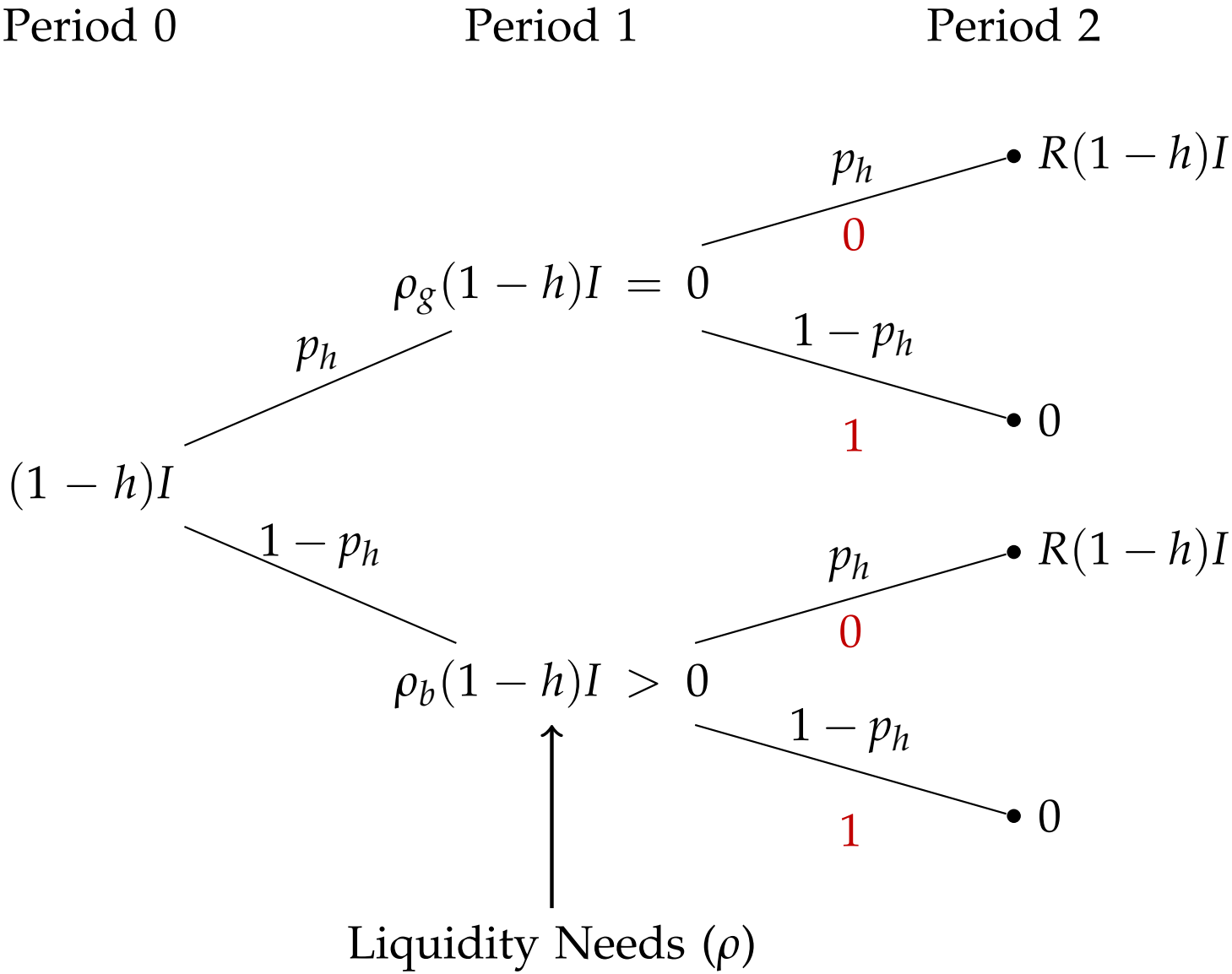
Note: Probabilities assume high bank effort

Private Investment Technology



Note: Probabilities assume high bank effort

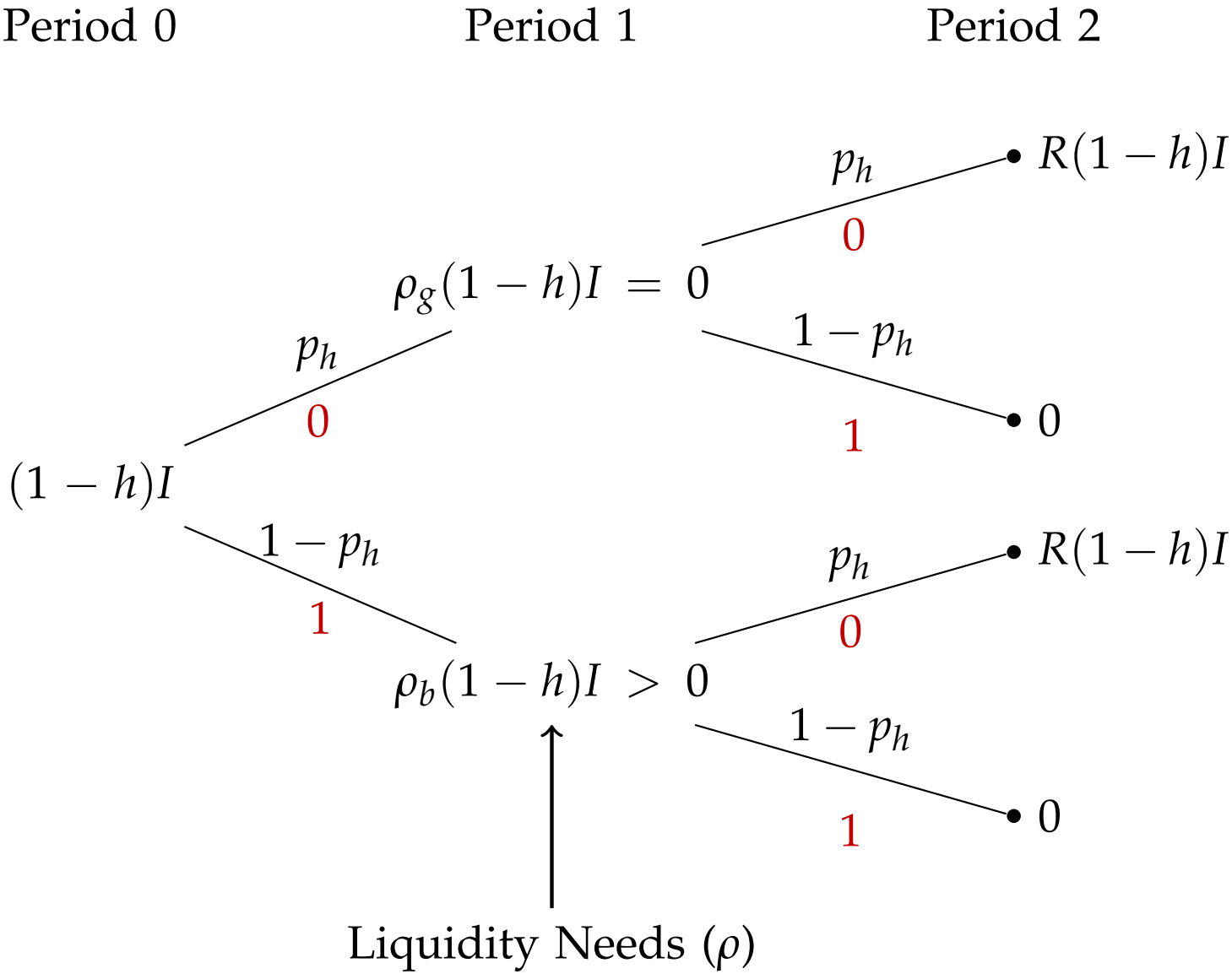
Private Investment Technology



Note: Probabilities assume high bank effort

Note: Red probabilities assume low bank effort, simplified relative to paper

Private Investment Technology



Note: Probabilities assume high bank effort

Note: Red probabilities assume low bank effort, simplified relative to paper

Optimal Contracts

- A *Contract* is $C = \left\{ I, h, x(\rho), R_f(\rho) \right\}$
  - I: scale of investment
  - h: fraction in public investment
  - $x(\rho)$: continuation rule
  - $R_f(\rho)$: rate of return paid to bank in event of success

Optimal Contracts

- A *Contract* is $C = \left\{ I, h, x(\rho), R_f(\rho) \right\}$
  - I: scale of investment
  - h: fraction in public investment
  - $x(\rho)$: continuation rule
  - $R_f(\rho)$: rate of return paid to bank in event of success

- Maximize bank's welfare subject to
  - Lender's participation
  - Bank's period 1 and 2 incentives
  - Credibility constraints:
    - *For each ρ, no pareto improving continuation contract exists*
    - Re-negotiation costs $= \kappa(1-h)I$ with $\kappa > 0$

Characterizing Optimal Contracts

- Value of optimal contract can be written as

$$V(h, x_g, x_b) = m(h, x_g, x_b) I(h, x_g, x_b)$$

  where
  - $m(\cdot)$ represents social rate of return
  - I represents scale of investment, nests moral hazard distortions

Characterizing Optimal Contracts

- Value of optimal contract can be written as

$$V(h, x_g, x_b) = m(h, x_g, x_b) I(h, x_g, x_b)$$

  where
  - $m(\cdot)$ represents social rate of return
  - I represents scale of investment, nests moral hazard distortions

- $m(\cdot)$ increasing in x_g and x_b
  - Projects are positive NPV for all liquidity needs ρ

Characterizing Optimal Contracts

- Value of optimal contract can be written as

$$V(h, x_g, x_b) = m(h, x_g, x_b) I(h, x_g, x_b)$$

  where
  - $m(\cdot)$ represents social rate of return
  - I represents scale of investment, nests moral hazard distortions

- $m(\cdot)$ increasing in x_g and x_b
  - Projects are positive NPV for all liquidity needs ρ

- $I(\cdot)$ increasing in x_g, *decreasing* in x_b
  - Optimal to "reward" bank after good liquidity shock & high returns
  - Optimal to "punish" bank after bad liquidity shock
  - Re-financing after bad liquidity shock ($x_b = 1$) limits punishments

Characterizing Optimal Contracts

- In paper, develop conditions so that optimality features

Characterizing Optimal Contracts

- In paper, develop conditions so that optimality features

  1. No public investment ($h = 0$)

     - R^S small so that $V_h < 0$

Characterizing Optimal Contracts

- In paper, develop conditions so that optimality features

  1. No public investment ($h = 0$)

     - R^S small so that $V_h < 0$

  2. Commitment to liquidate after bad liquidity shock ($x_b = 0$)

     - Moral hazard severe so that $V_{x_b}(h = 0, x_g = 1, x_b) < 0$

Characterizing Optimal Contracts

- In paper, develop conditions so that optimality features

  1. No public investment ($h = 0$)
     - R^S small so that $V_h < 0$
  2. Commitment to liquidate after bad liquidity shock ($x_b = 0$)
     - Moral hazard severe so that $V_{x_b}(h = 0, x_g = 1, x_b) < 0$
  3. Commitment to liquidate is *credible*
     - κ, renegotiation costs, large:

$$\kappa > p_h R - \rho_b - B > 0$$

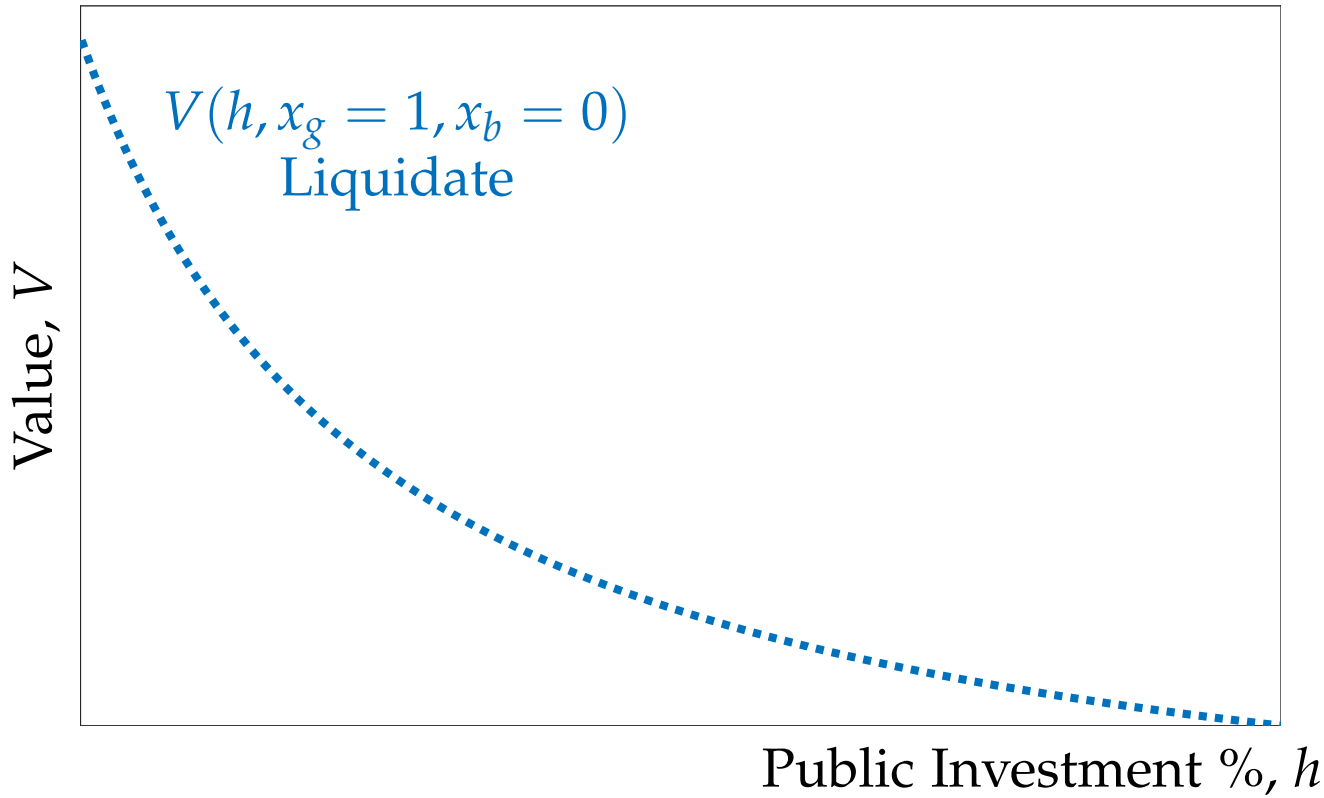
Characterizing Optimal Contracts

- In paper, develop conditions so that optimality features

  1. No public investment ($h = 0$)
     - R^S small so that $V_h < 0$
  2. Commitment to liquidate after bad liquidity shock ($x_b = 0$)
     - Moral hazard severe so that $V_{x_b}(h = 0, x_g = 1, x_b) < 0$
  3. Commitment to liquidate is *credible*
     - κ, renegotiation costs, large:

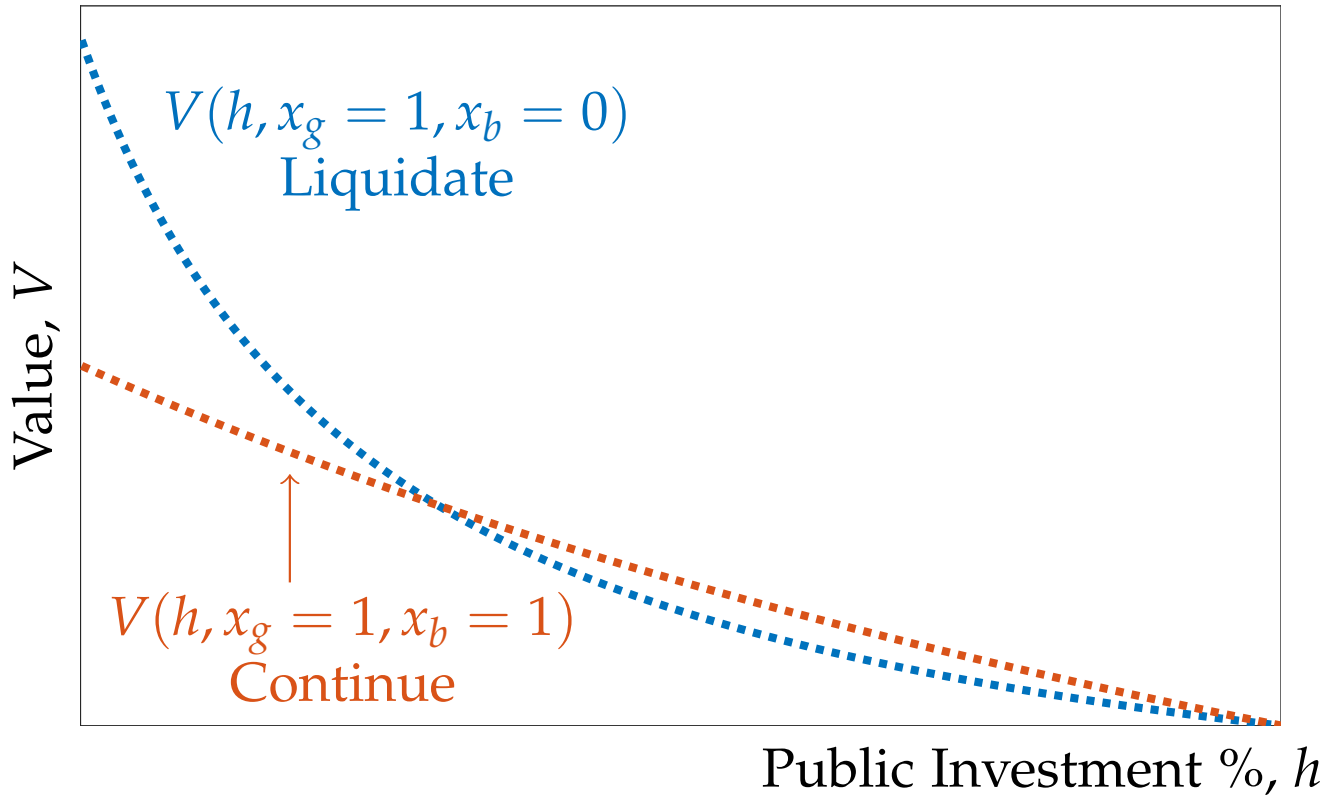
$$\kappa > \underbrace{p_h R - \rho_b}_{\text{Social Return to Refinancing}} - \underbrace{B}_{\text{Moral Hazard Cost}} > 0$$

Illustration of the Optimal Contract



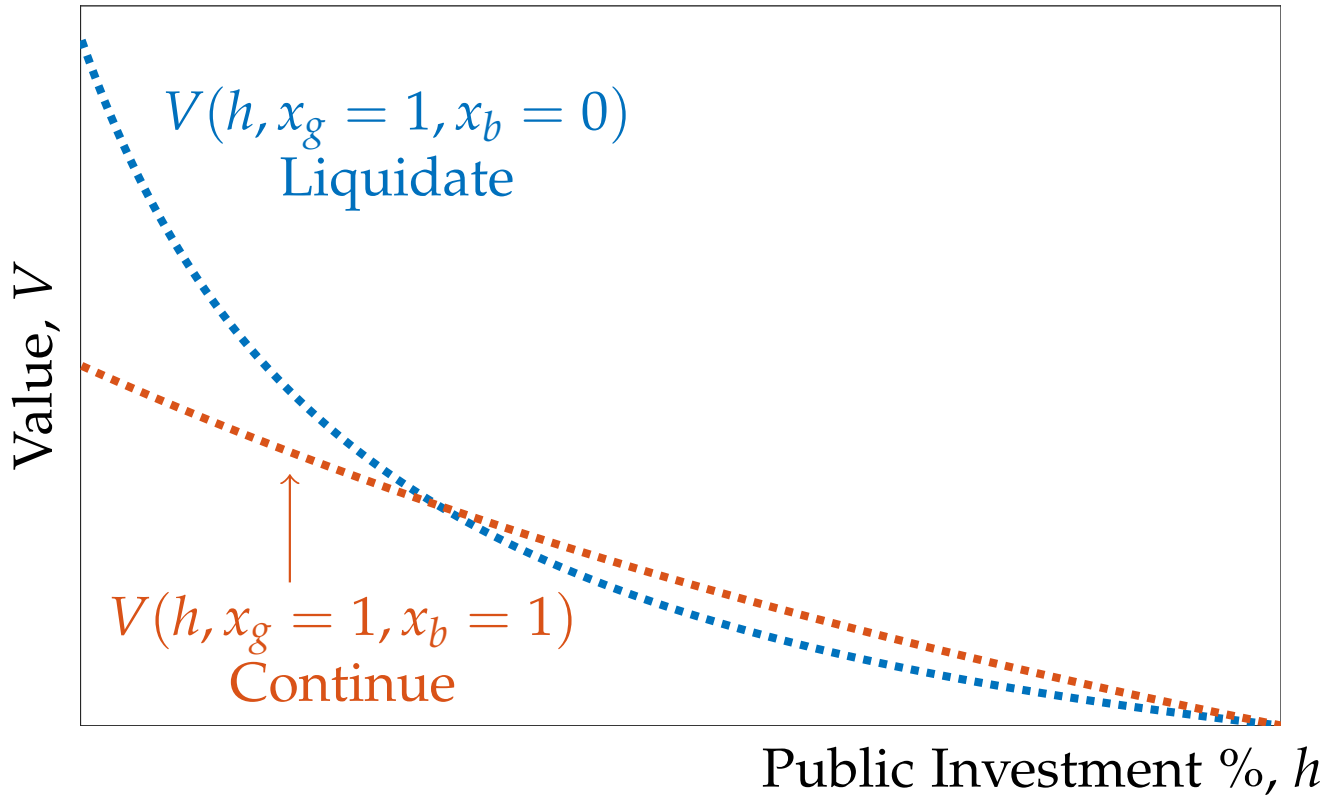
- $V(\cdot)$ decreasing in h

Illustration of the Optimal Contract



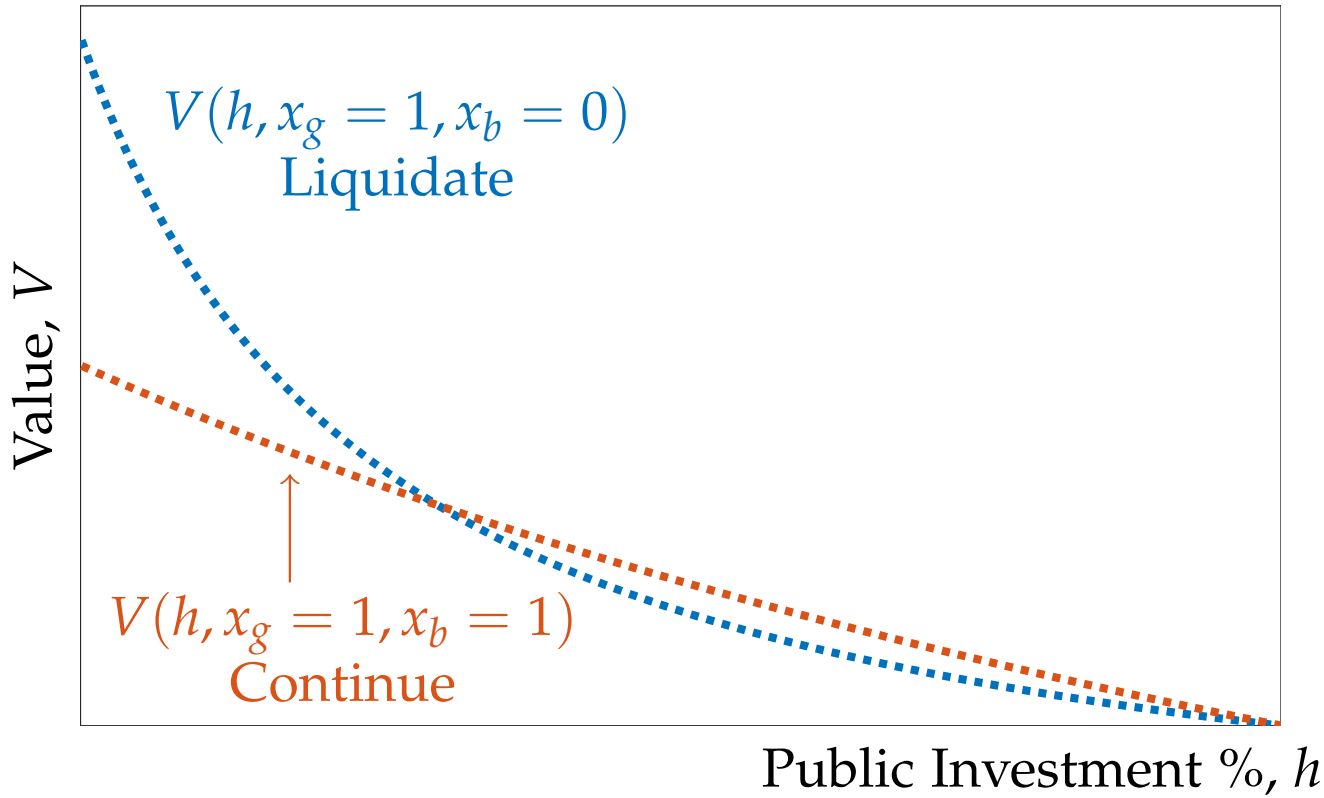
- $V(\cdot)$ decreasing in h

Illustration of the Optimal Contract



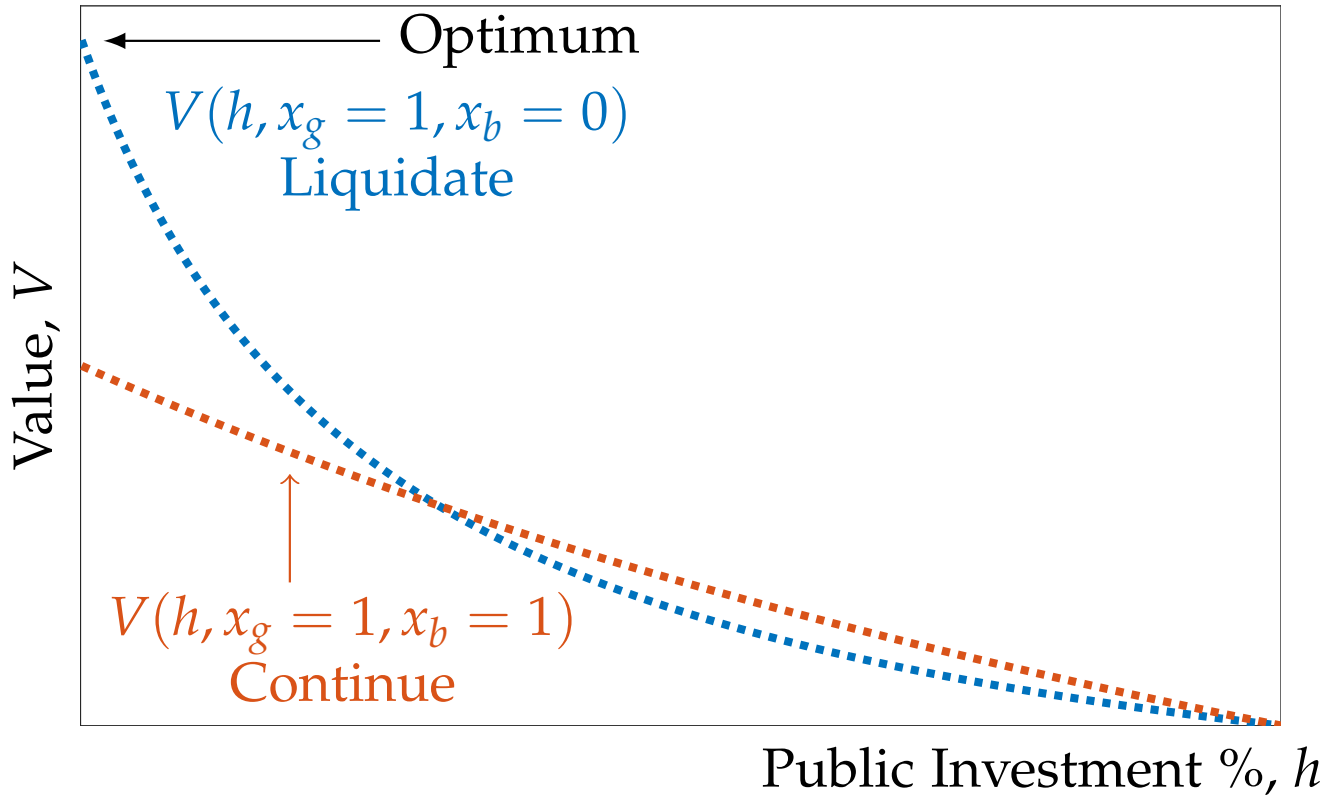
- $V(\cdot)$ decreasing in h
- When h small, incentive benefit of $x_b = 0$ large
  - Optimal to liquidate after ρ_b

Illustration of the Optimal Contract



- $V(\cdot)$ decreasing in h
- When h small, incentive benefit of $x_b = 0$ large
  - Optimal to liquidate after ρ_b
- When h large, incentive benefit of $x_b = 0$ small
  - Optimal to continue after ρ_b

Illustration of the Optimal Contract



- $V(\cdot)$ decreasing in h
- When h small, incentive benefit of $x_b = 0$ large
  - Optimal to liquidate after ρ_b
- When h large, incentive benefit of $x_b = 0$ small
  - Optimal to continue after ρ_b

Government Interventions and Optimal Home Bias

The Government

- Third Agent: Sovereign, or *domestic government*
- Issues risky claims to period 2 cons. in period 0 and period 1
- Debt Prices: $q_0(D_0)$ and $q_1(D_0, D_1)$ with $q_{t,D_t} < 0$

The Government

- Third Agent: Sovereign, or *domestic government*
- Issues risky claims to period 2 cons. in period 0 and period 1
- Debt Prices: $q_0(D_0)$ and $q_1(D_0, D_1)$ with $q_{t,D_t} < 0$
- Government may "bailout" bank by injecting resources in period 1
  - Benevolent government without commitment to not intervene
  - Bailout conditional on bank engaging in successful re-negotiation
- Bailout financed with new debt issues in period 1
  - New issues equal in seniority to period 0 debt

The Government

- Third Agent: Sovereign, or *domestic government*
- Issues risky claims to period 2 cons. in period 0 and period 1
- Debt Prices: $q_0(D_0)$ and $q_1(D_0, D_1)$ with $q_{t,D_t} < 0$
- Government may "bailout" bank by injecting resources in period 1
  - Benevolent government without commitment to not intervene
  - Bailout conditional on bank engaging in successful re-negotiation
- Bailout financed with new debt issues in period 1
  - New issues equal in seniority to period 0 debt
- In (forecasted) absence of intervention, $R^S = q_1(D_0, 0)/q_0(D_0)$

Optimal Contracts

- Optimal Contracts Maximize bank's welfare subject to
  - Lender's participation
  - Bank's period 1 and 2 incentives
  - Credibility constraint with Active Government:

    For each ρ, there exists no D_1 s.t. a pareto improving continuation exists

Credibility with an Active Government

- Plan to re-finance $x(\rho) = 1$ always credible
- Credibility only constrains plans to liquidate $x(\rho) = 0$

Credibility with an Active Government

- Plan to re-finance $x(\rho) = 1$ always credible
- Credibility only constrains plans to liquidate $x(\rho) = 0$
- Consider plan to liquidate in bad state: $x(\rho_b) = 0$

Credibility with an Active Government

- Plan to re-finance $x(\rho) = 1$ always credible
- Credibility only constrains plans to liquidate $x(\rho) = 0$
- Consider plan to liquidate in bad state: $x(\rho_b) = 0$
- Plan to liquidate is credible if and only if for all D_1,

$$F(h, I, D_1) \leq hIR^S$$

where $F(\cdot)$ is renegotiated value of bank and

$$F(h, I, D_1) = q_1(D_0, D_1)D_1 + Ih\frac{q_1(D_0, D_1)}{q_0(D_0)} + I(1-h)\left(p_h R - \rho_b - B - \kappa\right)$$

Credibility with an Active Government

- Plan to re-finance $x(\rho) = 1$ always credible
- Credibility only constrains plans to liquidate $x(\rho) = 0$
- Consider plan to liquidate in bad state: $x(\rho_b) = 0$
- Plan to liquidate is credible if and only if for all D_1,

$$F(h, I, D_1) \leq hIR^S$$

where $F(\cdot)$ is renegotiated value of bank and

$$F(h, I, D_1) = \underbrace{q_1(D_0, D_1)D_1}_{\text{Bailout}} + \underbrace{Ih\frac{q_1(D_0, D_1)}{q_0(D_0)}}_{\text{Dilution Effect}} + \underbrace{I(1-h)\left(p_h R - \rho_b - B - \kappa\right)}_{\text{Re-financed Value of Private Investment}}$$

Proposition (*Optimal Public Investment*)

Suppose an initial level of domestic debt, $\bar{D}_0$, exists satisfying

1. Given, $\bar{D}_0$ exists such that plan to liquidate is credible when $h = 0$;
2. Plan to liquidate is *not* credible with $h = 0$ when $D_0 = \bar{D}_0 + \epsilon$;
3. Dilution effect at $\bar{D}_0$ is sufficiently strong.

Then D_0 exists such that strictly positive public investment is optimal.

Bailouts and Public Investment

Proposition (*Optimal Public Investment*)

Suppose an initial level of domestic debt, $\bar{D}_0$, exists satisfying

1. Given, $\bar{D}_0$ exists such that plan to liquidate is credible when $h = 0$;
2. Plan to liquidate is *not* credible with $h = 0$ when $D_0 = \bar{D}_0 + \epsilon$;
3. Dilution effect at $\bar{D}_0$ is sufficiently strong.

Then D_0 exists such that strictly positive public investment is optimal.

- Proof (sketch):
  - At $\bar{D}_0$, gov't cannot finance a bailout even when $h = 0$
  - Small change in D_0 makes bailouts easier
    $\Rightarrow$ *tightens* credibility constraint
  - Dilution effect strong implies increase in h makes bailouts harder
    $\Rightarrow$ *relaxes* credibility constraint

Bailouts and Public Investment

Proposition (*Optimal Public Investment*)

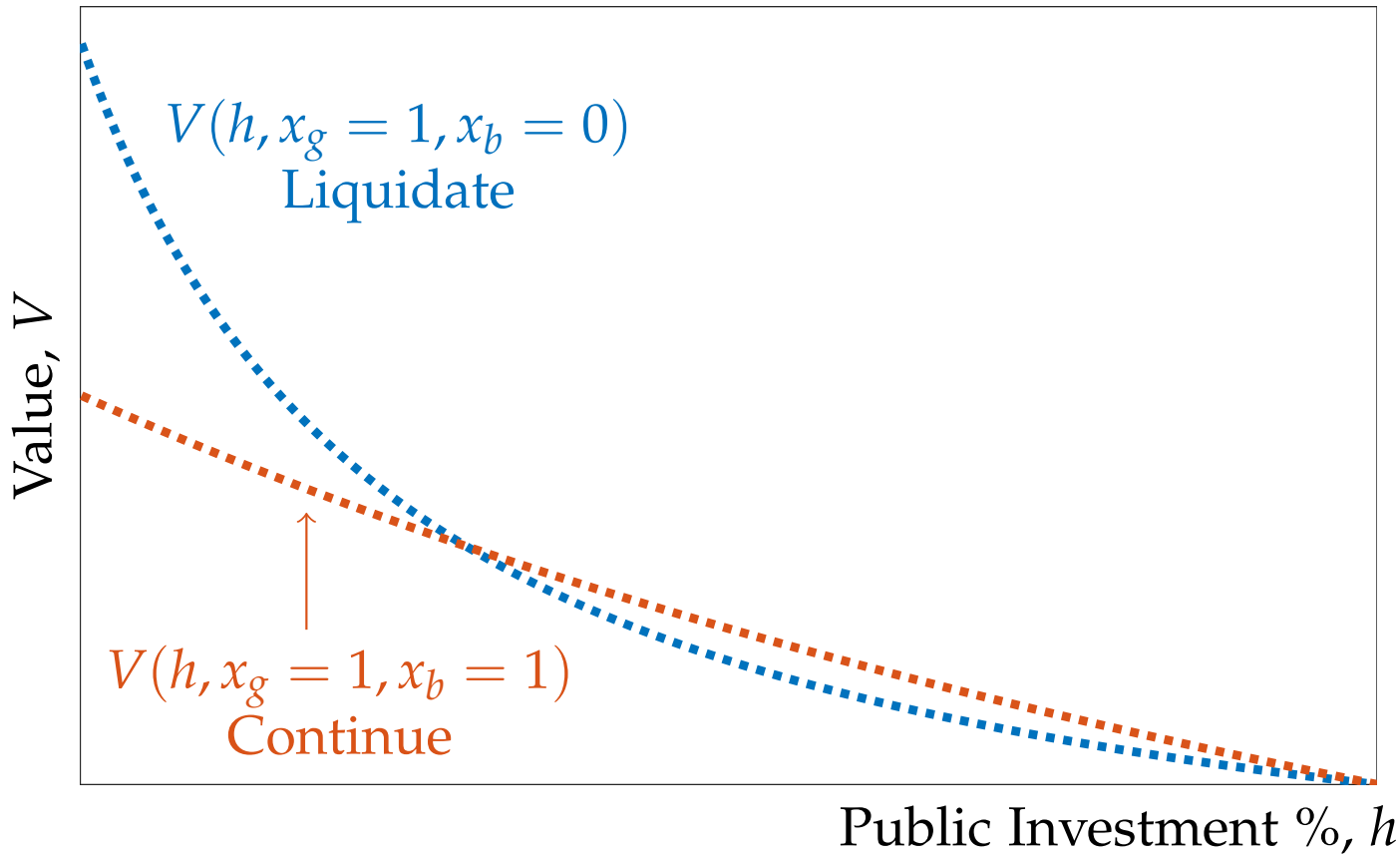
Suppose an initial level of domestic debt, $\bar{D}_0$, exists satisfying

1. Given, $\bar{D}_0$ exists such that plan to liquidate is credible when $h = 0$;
2. Plan to liquidate is *not* credible with $h = 0$ when $D_0 = \bar{D}_0 + \epsilon$;
3. Dilution effect at $\bar{D}_0$ is sufficiently strong.

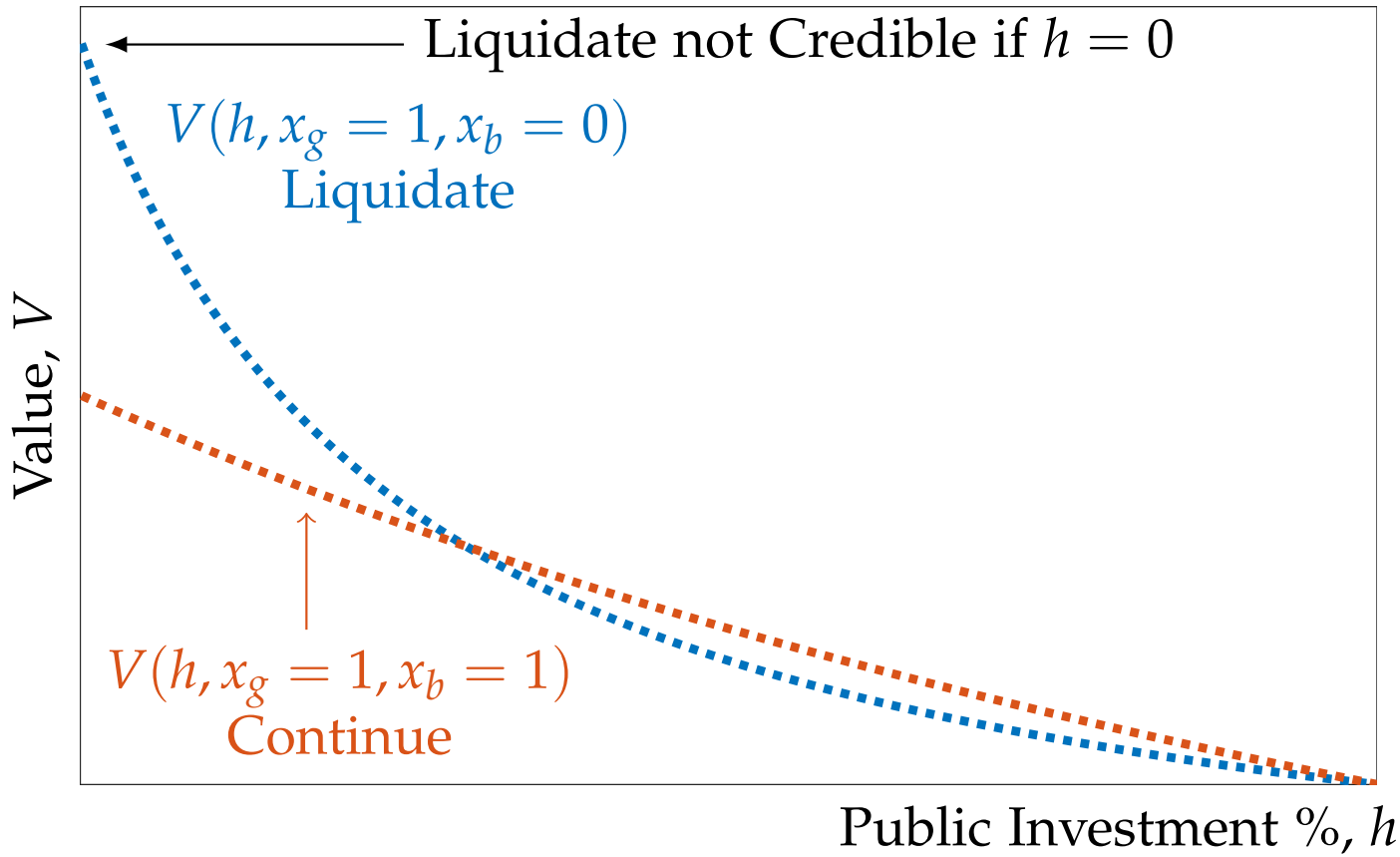
Then D_0 exists such that strictly positive public investment is optimal.

- Proof (sketch):
  - At $\bar{D}_0$, gov't cannot finance a bailout even when $h = 0$
  - Small change in D_0 makes bailouts easier
    $\Rightarrow$ *tightens* credibility constraint
  - Dilution effect strong implies increase in h makes bailouts harder
    $\Rightarrow$ *relaxes* credibility constraint
- Increasing h resolves gov't time inconsistency problem (at cost)

Bailouts and Public Investment

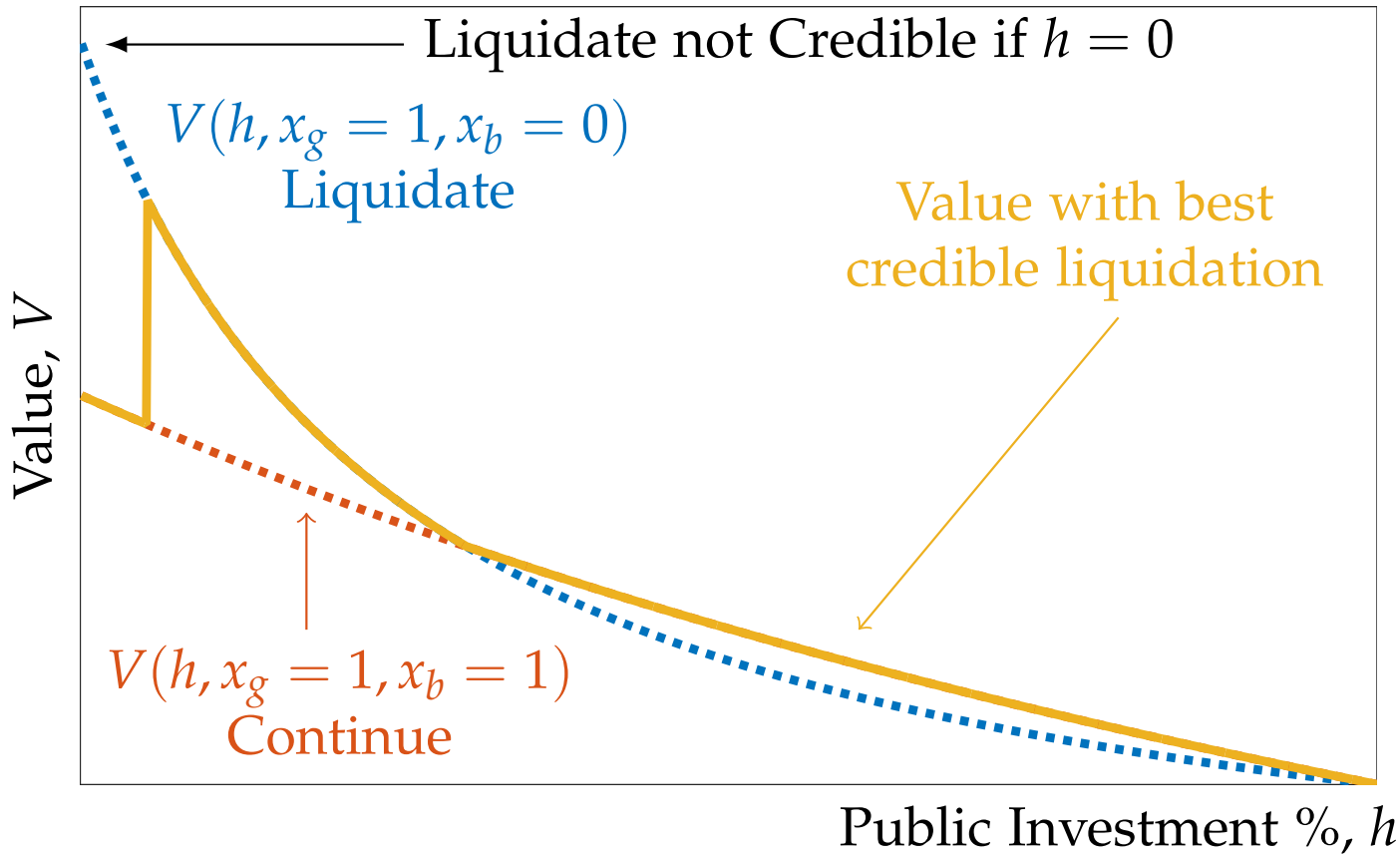


Bailouts and Public Investment



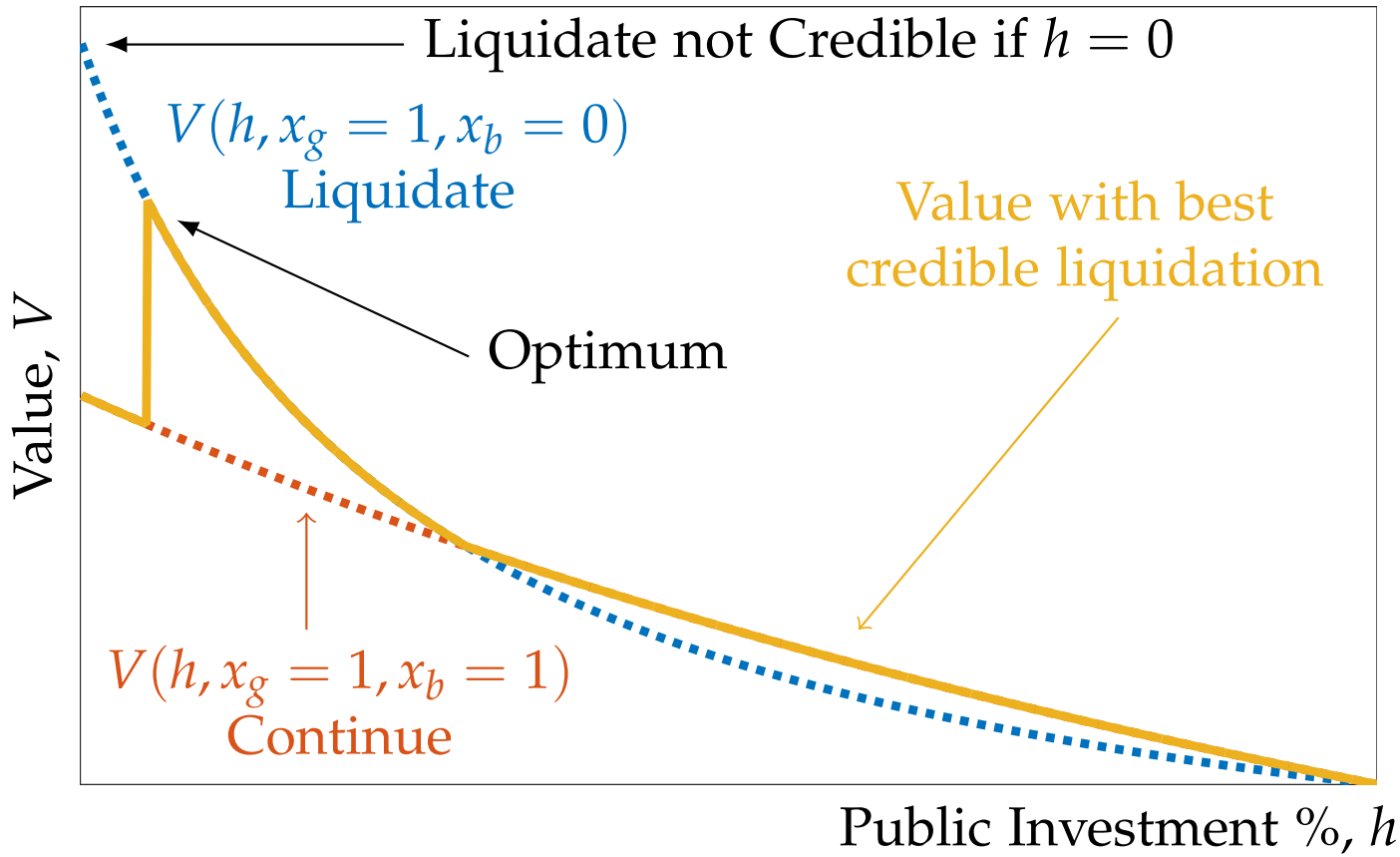
- With bailouts, $h = 0$ not credible

Bailouts and Public Investment



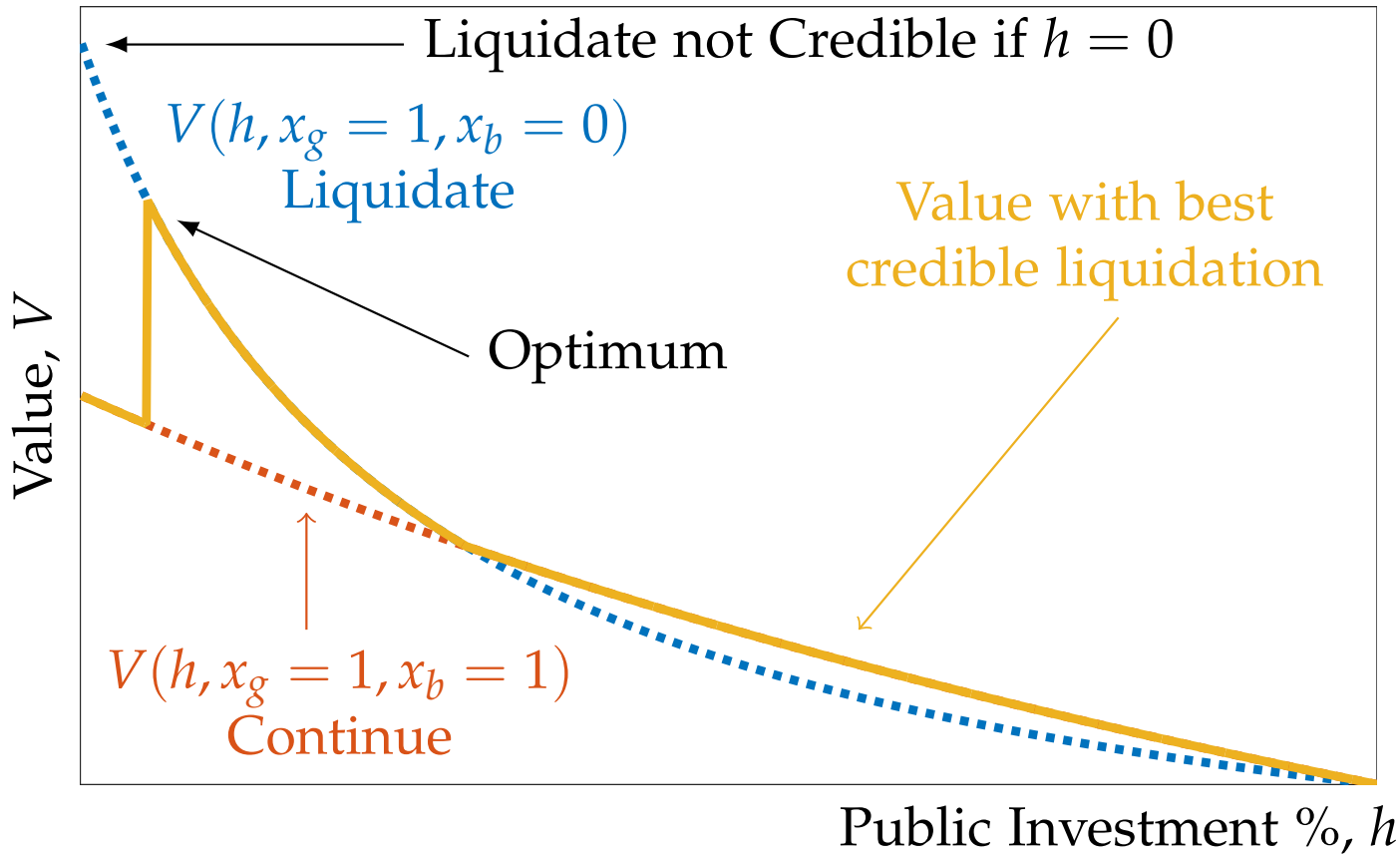
- With bailouts, $h = 0$ not credible
- Credible liquidation requires public investment

Bailouts and Public Investment



- With bailouts, $h = 0$ not credible
- Credible liquidation requires public investment

Bailouts and Public Investment



- With bailouts, $h = 0$ not credible
- Credible liquidation requires public investment
- Credible liquidation implies ex ante costs for Bank

Bailouts and Home Bias

- Necessary condition for $h > 0$: *dilution effect*

$$\frac{q_1(D_0, D_1)}{q_0(D_0)} < \frac{q_1(D_0, 0)}{q_0(D_0)} = R^S$$

- Sub-optimal for bank to buy public debt without this property
- Natural to think Foreign Sovereign debt lacks this property
  - If foreign Sovereigns do not bailout domestic banks, then bailouts impose no dilution effect on foreign holdings
  - Then domestic banks do not invest in foreign sovereign debt

Bailouts and Home Bias

- Necessary condition for $h > 0$: *dilution effect*

$$\frac{q_1(D_0, D_1)}{q_0(D_0)} < \frac{q_1(D_0, 0)}{q_0(D_0)} = R^S$$

- Sub-optimal for bank to buy public debt without this property
- Natural to think Foreign Sovereign debt lacks this property
  - If foreign Sovereigns do not bailout domestic banks, then bailouts impose no dilution effect on foreign holdings
  - Then domestic banks do not invest in foreign sovereign debt

Proposition (*Optimal Home Bias*)

If $h > 0$, banks choose to home bias their portfolio of sovereign debt.

Positive and Normative Implications of the Model

Positive Implications: The Evolution of Home Bias

- How does home bias respond to change in Sovereign Credit Risk?
  - Since onset of Sovereign Debt crisis in Europe, home bias decreases in Greece, increases in Italy, Spain (among others)
  - Will show our model capable of generating different patterns

Positive Implications: The Evolution of Home Bias

- How does home bias respond to change in Sovereign Credit Risk?
  - Since onset of Sovereign Debt crisis in Europe, home bias decreases in Greece, increases in Italy, Spain (among others)
  - Will show our model capable of generating different patterns
- Change in bailout capacity $\neq$ change in Sovereign credit risk

Positive Implications: The Evolution of Home Bias

- How does home bias respond to change in Sovereign Credit Risk?
  - Since onset of Sovereign Debt crisis in Europe, home bias decreases in Greece, increases in Italy, Spain (among others)
  - Will show our model capable of generating different patterns
- Change in bailout capacity $\neq$ change in Sovereign credit risk
- Change in bailout capacity depends on $q_{1,D_0}(D_0, D_1^*)$
  - Implied change on counterfactual price under "best" bailout

    "Best" bailout is D_1^* that maximizes re-negotiated value of bank

Sovereign Debt Pricing

- Government revenue in period 2:

$$T \sim U[\underline{T}, \bar{T}(D_0)], \text{with } \bar{T}(D_0) = T_{\max} + \phi D_0$$

- Repayment probability η given by $\eta_0(D_0), \eta_1(D_0, D_1)$

Sovereign Debt Pricing

- Government revenue in period 2:

$$T \sim U[\underline{T}, \bar{T}(D_0)], \text{with } \bar{T}(D_0) = T_{\max} + \phi D_0$$

- Repayment probability η given by $\eta_0(D_0), \eta_1(D_0, D_1)$

- Debt Prices:

$$q_0(D_0) = \frac{\eta(D_0)}{\sigma^2}, \qquad q_1(D_0, D_1) = \frac{\eta_1(D_0, D_1)}{\sigma}, \qquad \sigma < 1$$

Sovereign Debt Pricing

- Government revenue in period 2:

$$T \sim U[\underline{T}, \bar{T}(D_0)], \text{with } \bar{T}(D_0) = T_{\max} + \phi D_0$$

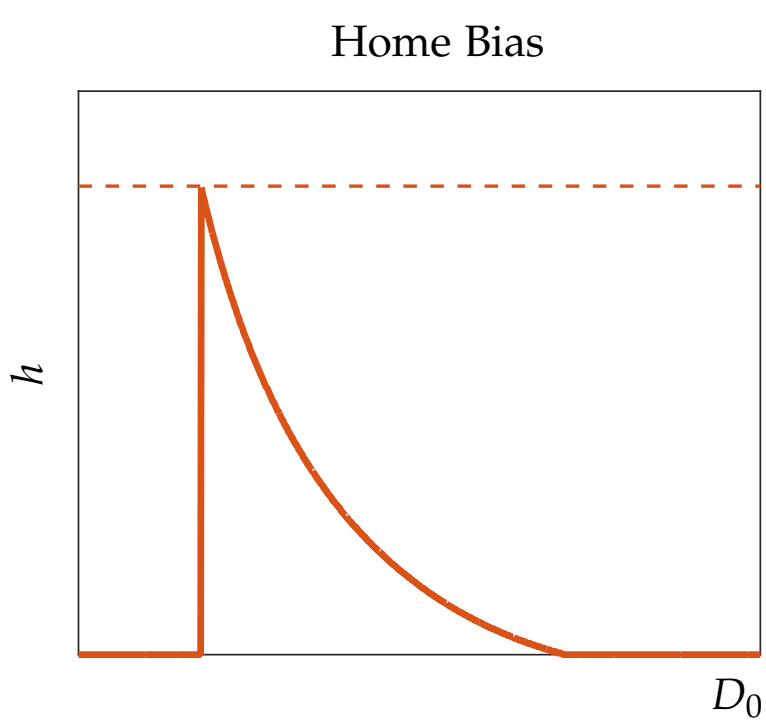
- Repayment probability η given by $\eta_0(D_0), \eta_1(D_0, D_1)$

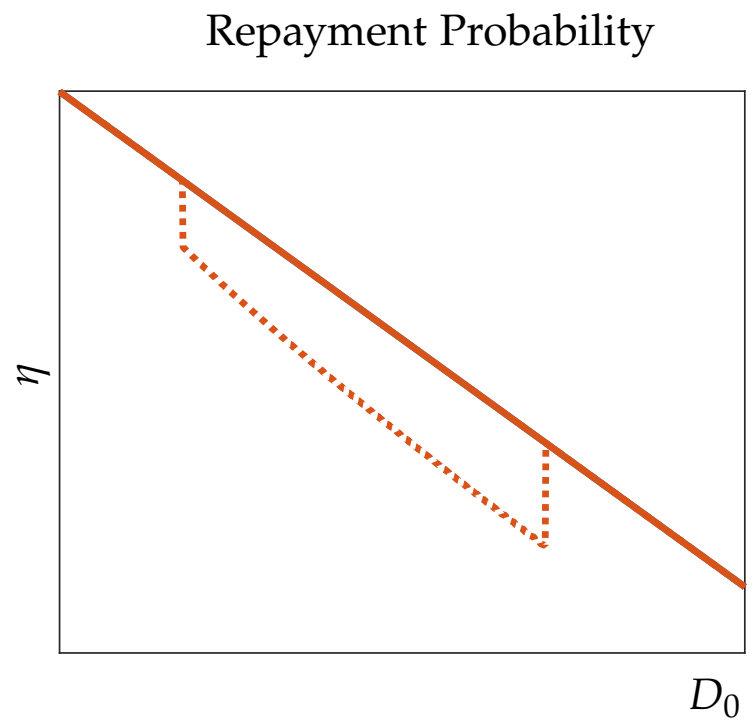
- Debt Prices:

$$q_0(D_0) = \frac{\eta(D_0)}{\sigma^2}, \qquad q_1(D_0, D_1) = \frac{\eta_1(D_0, D_1)}{\sigma}, \qquad \sigma < 1$$

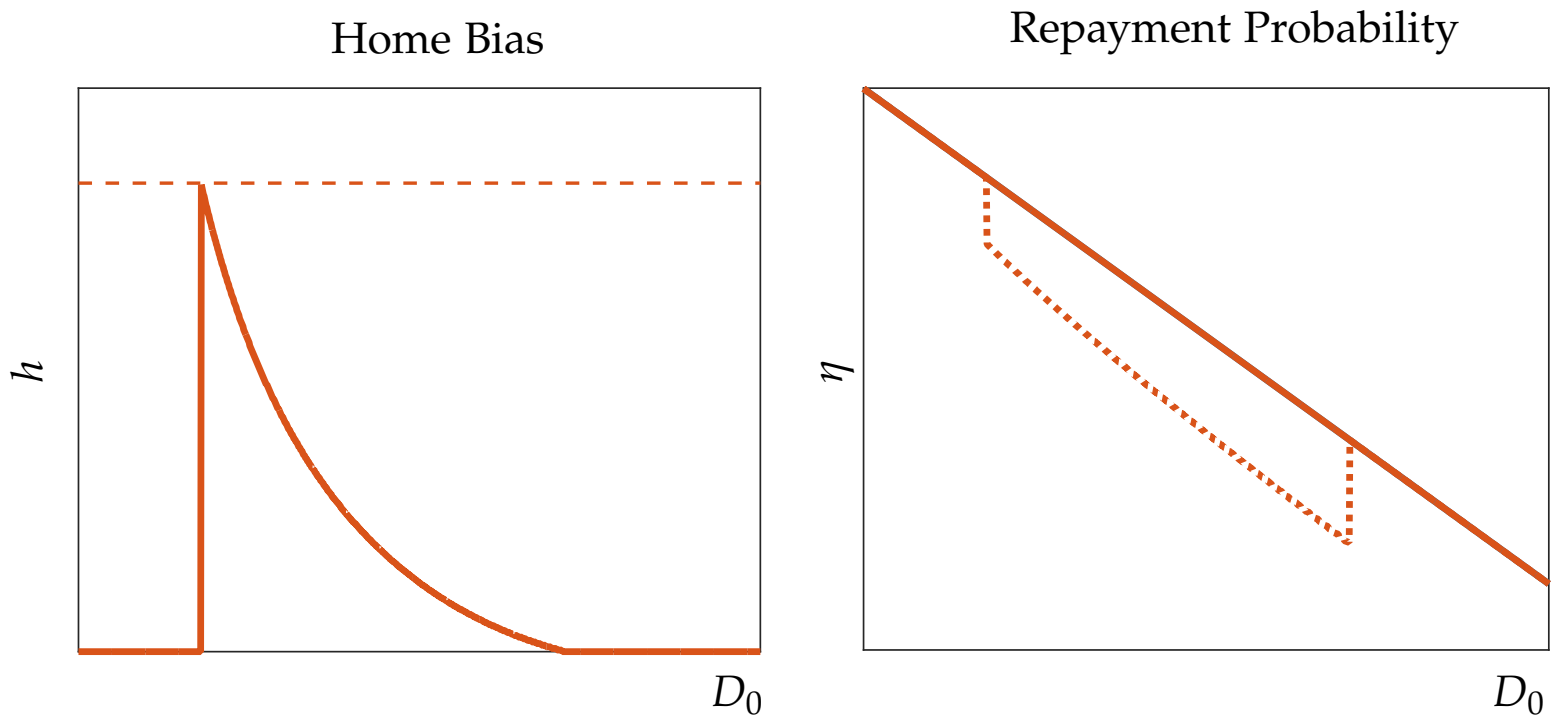
- Two Models of Default Risk:
  - *Unbacked* Debt: $\phi = 0$
    - Increase in outstanding debt associated with increase in default risk
  - *Partially Backed* Debt: $\phi > 0$
    - Increase in outstanding debt associated with increase in fiscal capacity

Impact of Changes in Unbacked Debt



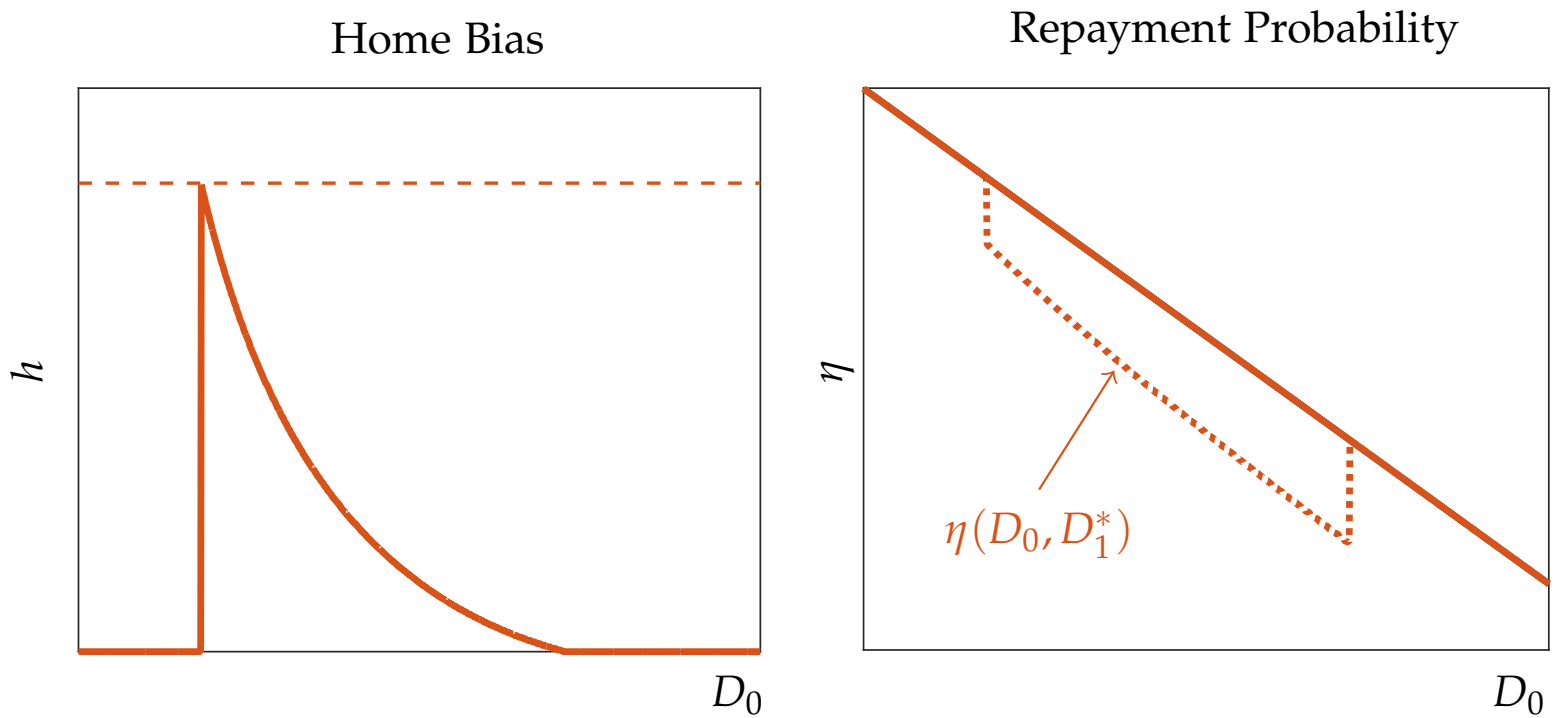


Impact of Changes in Unbacked Debt



- Increase in unbacked D_0 decreases home bias

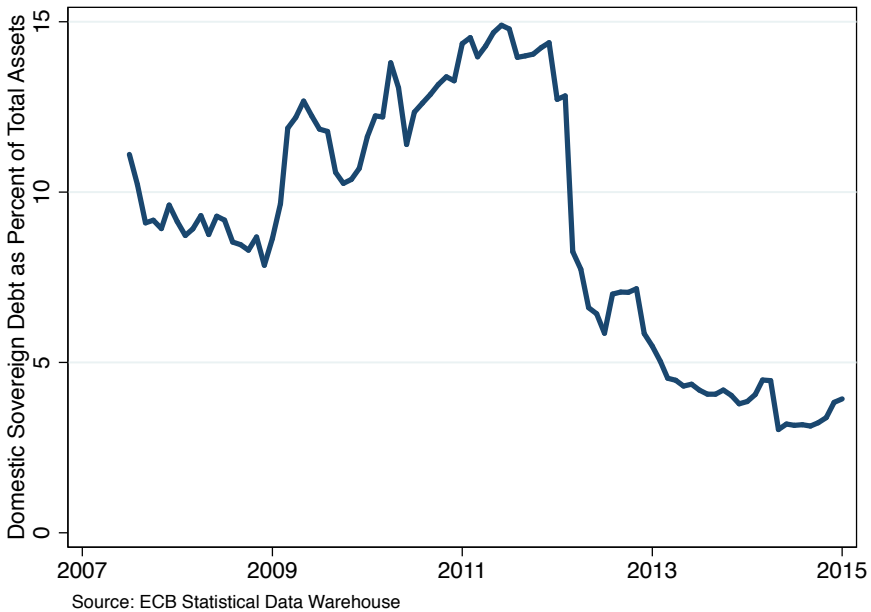
Impact of Changes in Unbacked Debt



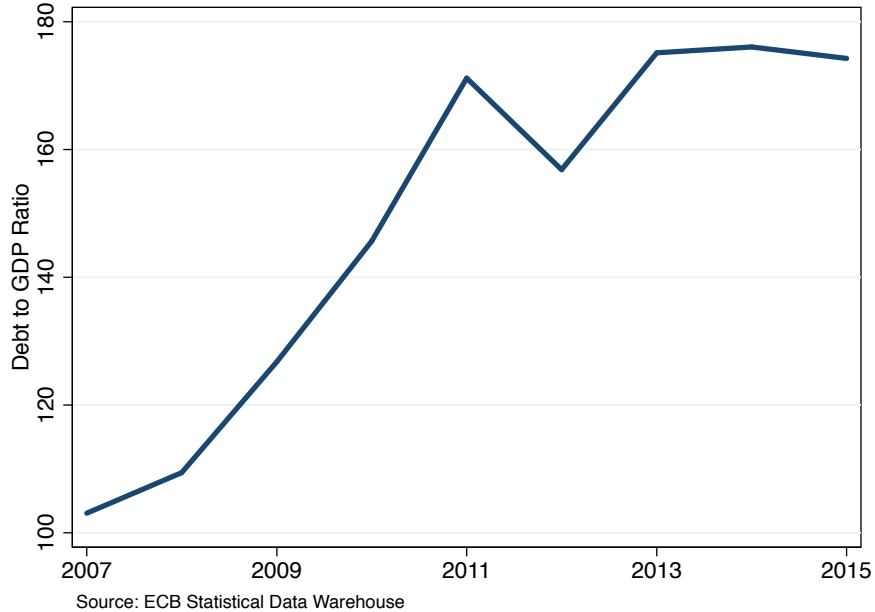
- Increase in unbacked D_0 decreases home bias
- Associated with reduced bailout capacity
  - Counterfactual repayment decreasing in D_0

Unbacked Debt Rationalizes Greek Experience

Home Bias: Public Debt-to-Assets

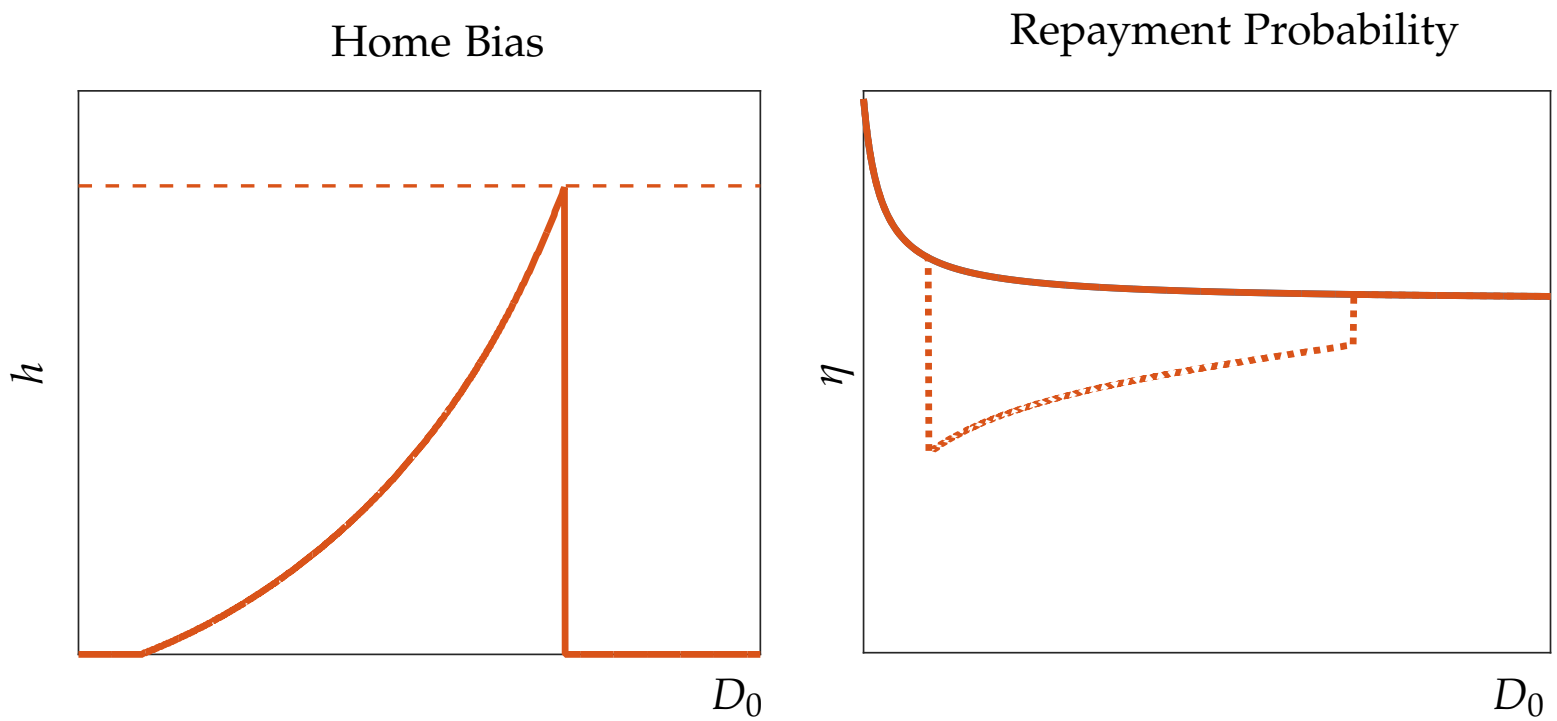


Debt-to-GDP

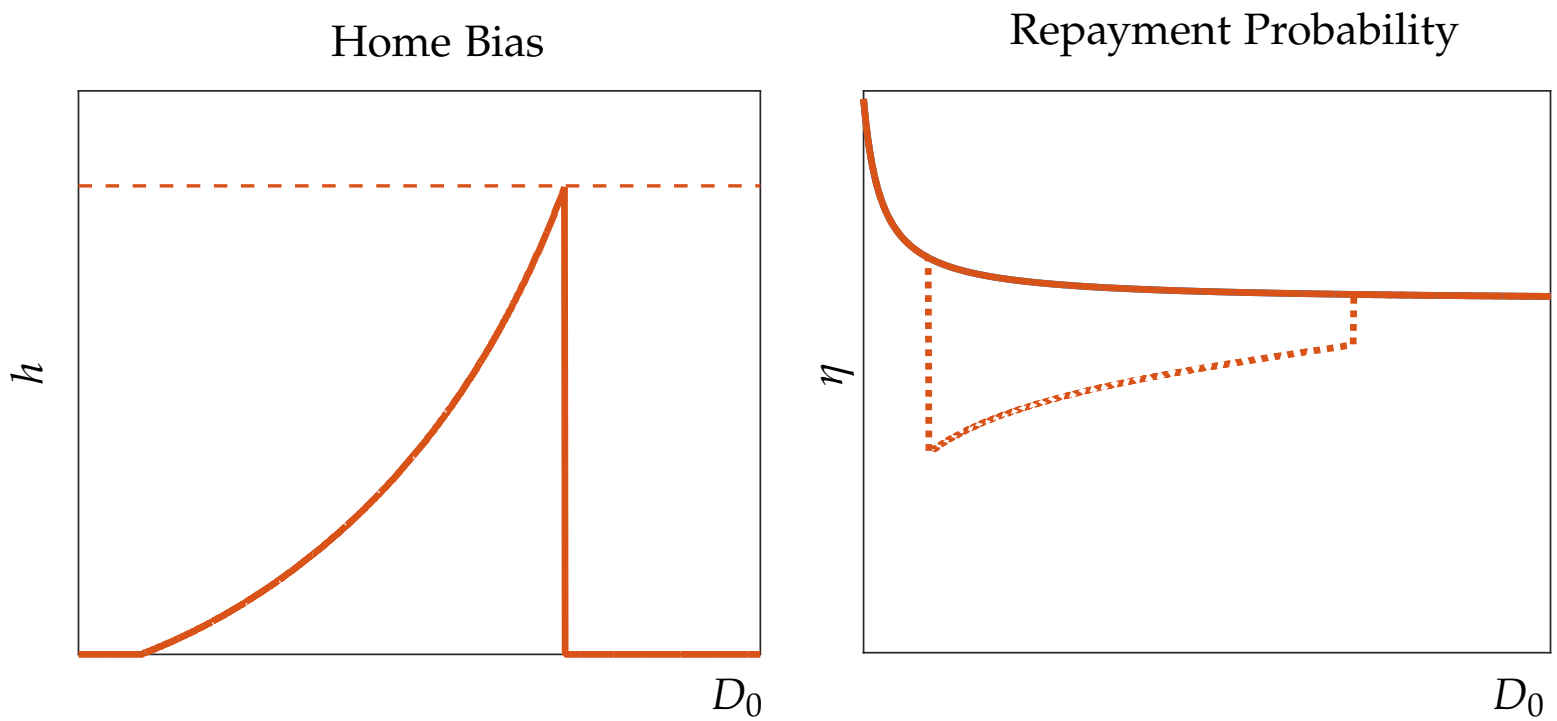


- Trend decline in home bias in Greece associated with increase in Debt-to-GDP
- Marked decline after Greek debt-devaluation
- Consistent with predictions of unbacked debt model

Impact of Changes in Partially Backed Debt

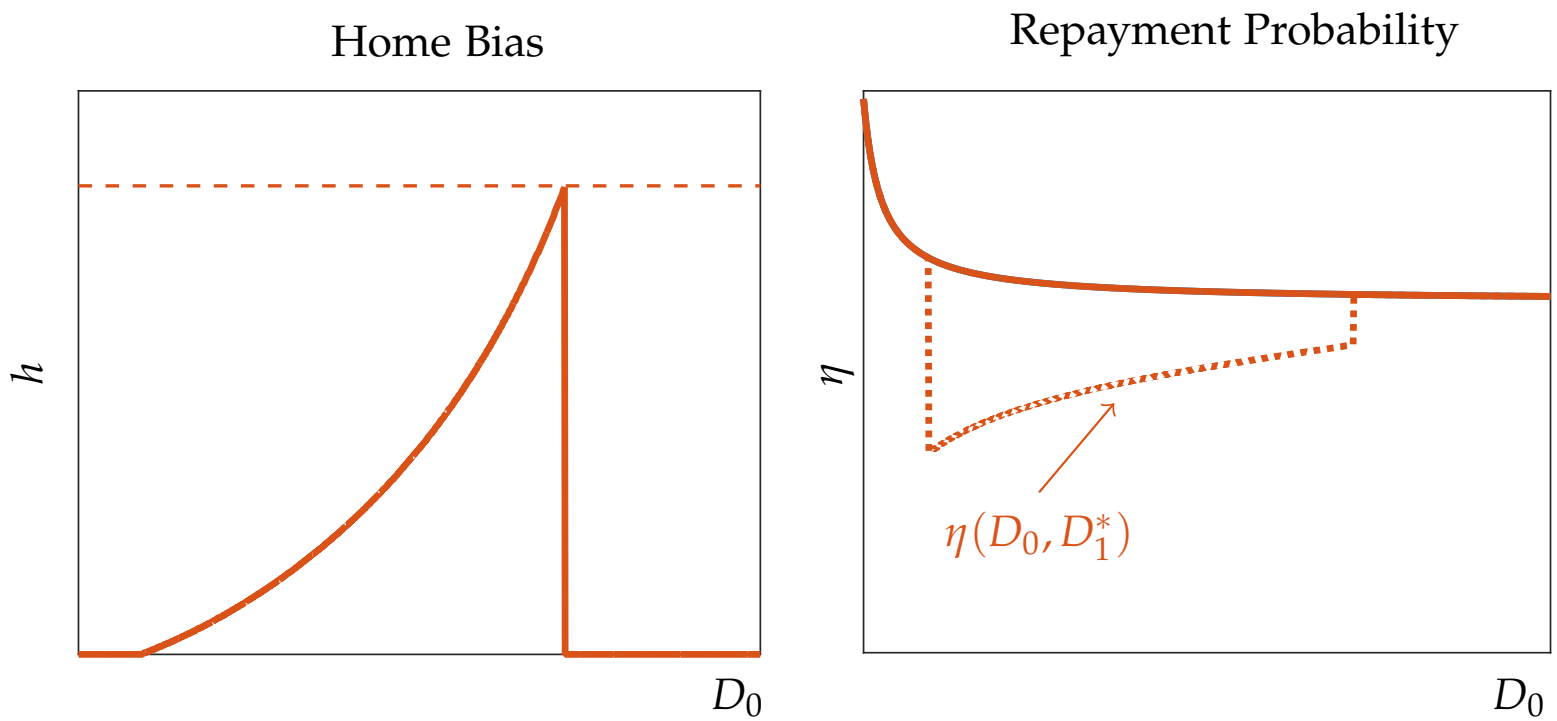


Impact of Changes in Partially Backed Debt



- Increase in partially backed D_0 *increases* home bias

Impact of Changes in Partially Backed Debt

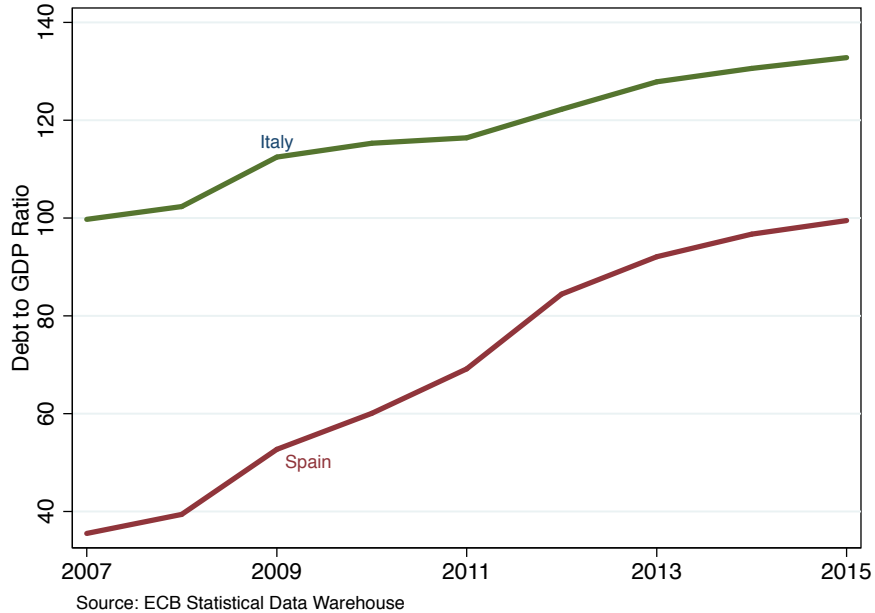


- Increase in partially backed D_0 *increases* home bias
- Associated with increased bailout capacity
  - Counterfactual repayment increasing in D_0
  - Note: Equilibrium repayment rate still decreasing

Partially Backed Debt Rationalizes Italy and Spain

Home Bias: Public Debt-to-Assets

Debt-to-GDP



- Trend rise in home bias in Italy and Spain
- Trend rise in Debt-to-GDP in these countries
- Consistent with predictions of partially backed debt model

Normative Implications

- Bailout mechanisms created since onset of Euro Zone Crisis
  - Examples: European Stability Mechanism, EFSF, and EFSM
- An authority that does not issue debt and has bailout capacity:
  - increases ex post welfare: bailouts are possible
  - decreases ex ante welfare: induces managerial moral hazard
- Recent proposals for EU to issue Eurobonds
  - Euro Banks will be prospective clients?
  - Implies increase in ex ante welfare: reduced bank moral hazard
  - Implies more fragility: reduced EU bailout capacity
- Eurobonds may reinforce ex ante incentives, making European financial system *less* resilient to shocks

Conclusions

- Home Bias limits effectiveness of Gov't Bailouts
- Home Bias may arise as privately optimal response of depositors and banks to bailout expectations which induce moral hazard in financial sector
- Home Bias is a market-based mechanism to resolve government's time inconsistency problem
- Model capable of generating salient features of evolution of home bias during recent European experience
- Preventing home bias may entail unintended costs