Shadow Banking and Market Discipline on Traditional Banks

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This Paper

Questions:

- Can shadow banks exist without regulatory arbitrage?
- How do shadow banks affect market discipline (on traditional banks)?
- Implications for systemic risk and policy design?

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Approach: Model with free entry into shadow banking

- Market discipline: depositors may withdraw early
- Traditional banking: remain safe to avoid withdrawal
- Shadow banking: risky portfolio, early withdrawal in crisis
- Fire-sale externalities (participate in the same secondary market)

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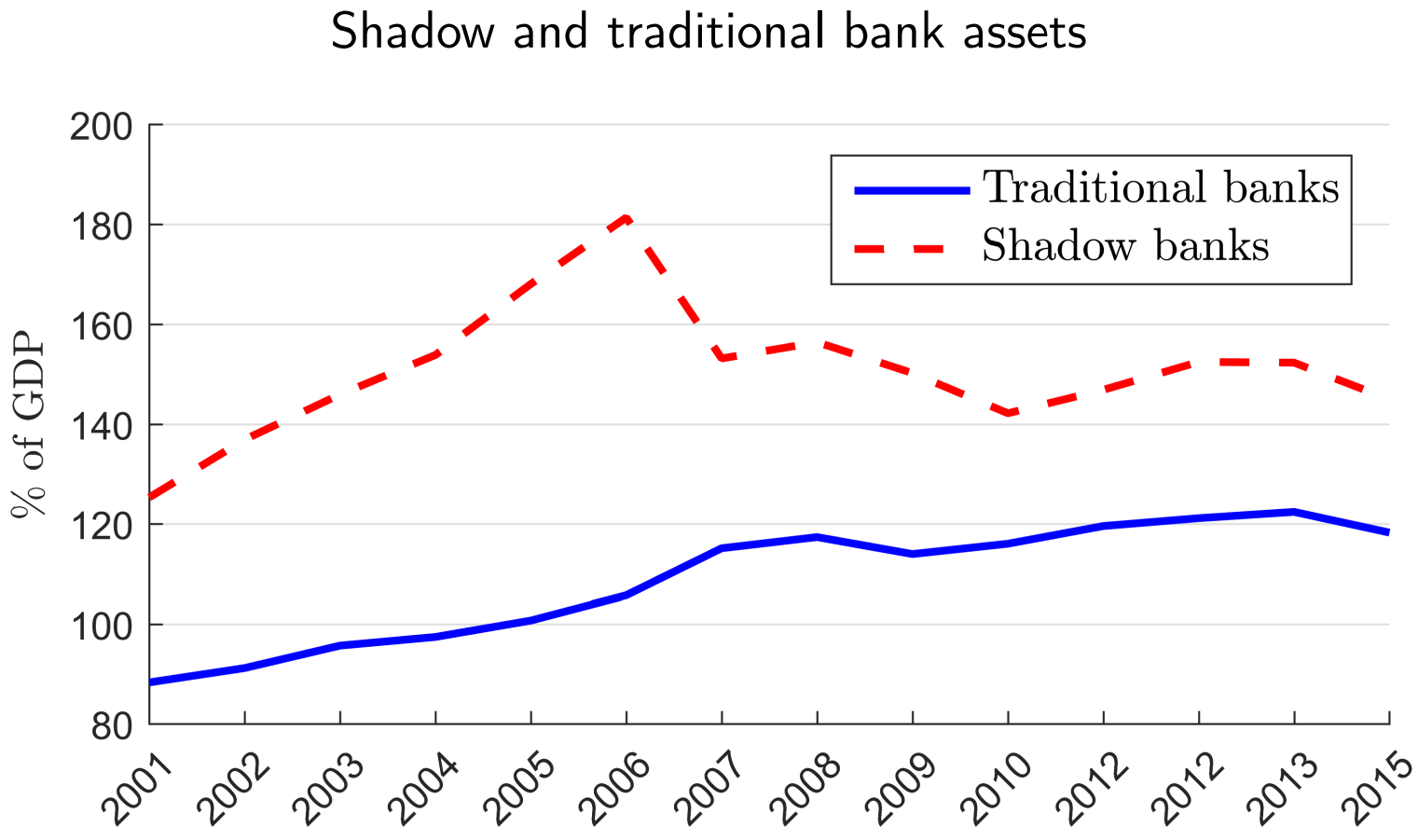
Preview of Main Results:

- Shadow banking expands until it causes fire-sale in equilibrium
- Fire-sale leaves traditional banks vulnerable to liquidity shocks
- Undermines market discipline on traditional banks
- Policy: tax on shadow banks or secondary market to reduce sector size to social optimal

Motivating evidence from the 2008 financial crisis

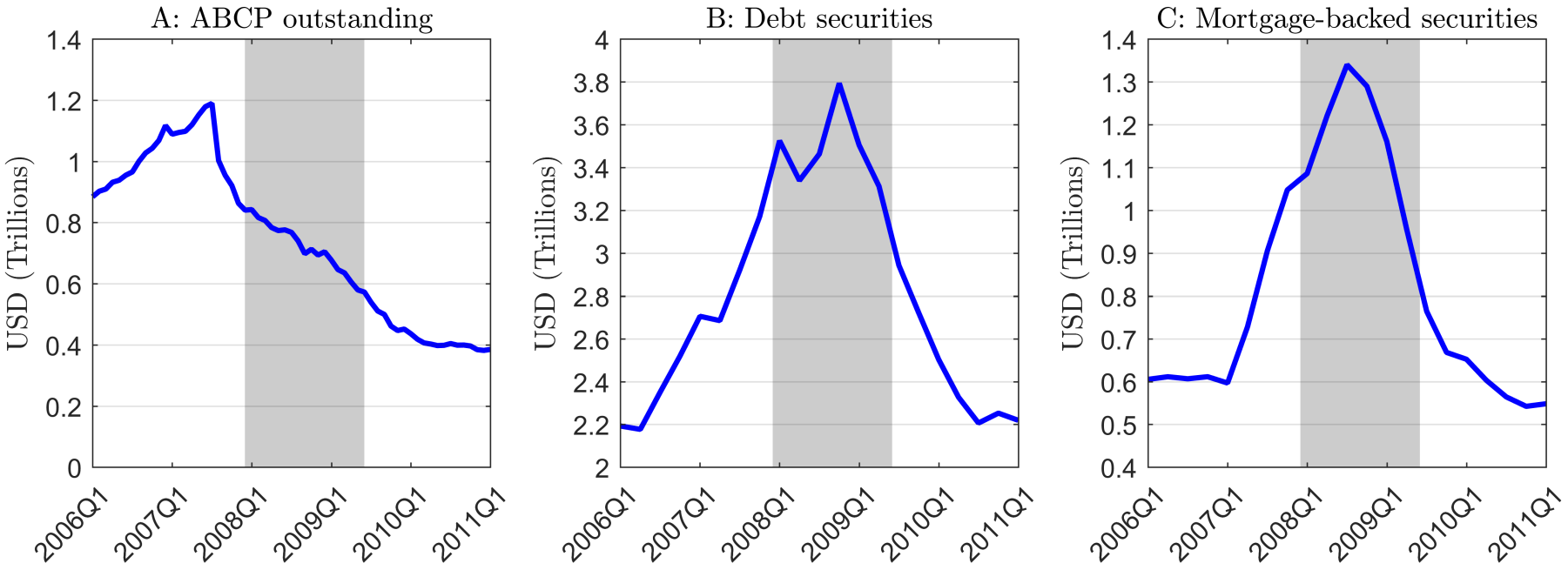
- Shadow banks: Sector expanded rapidly in the decade before the crisis



Note: Financial assets when available, otherwise total assets.

Motivating evidence from the 2008 financial crisis

- Shadow banks: Sudden dry-up of funding and liquidation of assets during crisis

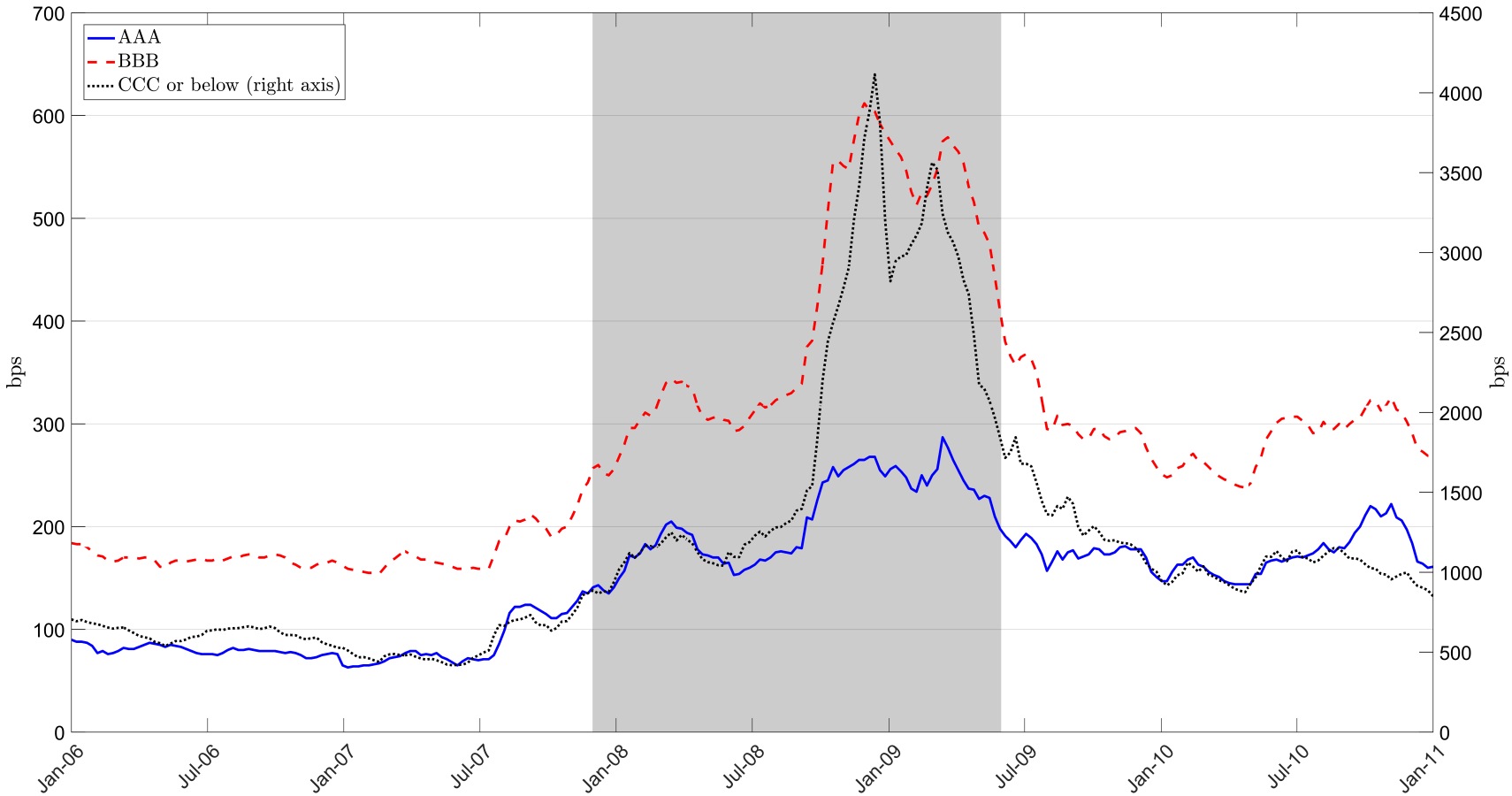


Note: Shaded areas indicate US recessions. Shadow banks refer to money market mutual funds, security brokers and dealers, and issuers of asset-backed securities. Mortgage-backed securities refer to agency- and GSE-backed securities. Source: Financial Accounts of the United States.

Motivating evidence from the 2008 financial crisis

- Fire-sale: Rise in spreads of both safe and risky assets

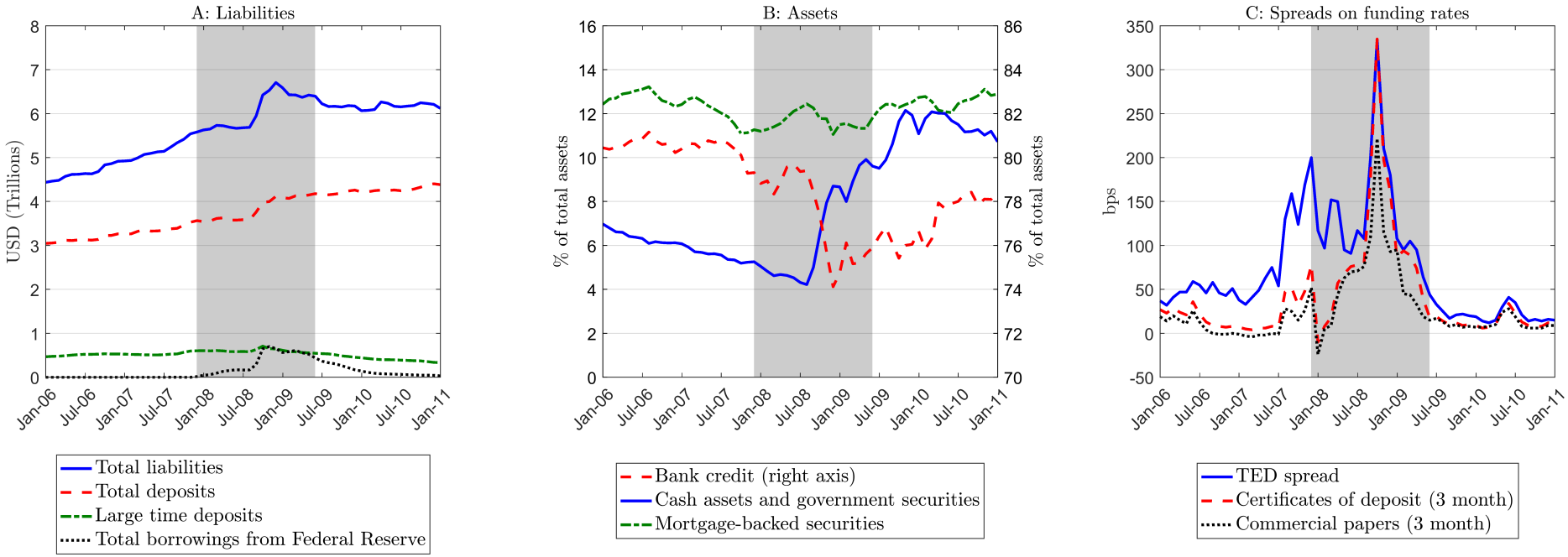
Spreads between corporate and Treasury bonds



Note: Shaded areas indicate US recessions. AAA (BBB) refers to the spread between Moody's Seasoned Aaa (Baa) Corporate Bonds and 10-Year Treasury bonds (constant maturity). CCC or below refers to the option-adjusted spread between the Bank of America Merrill Lynch US Corporate C Index and a spot Treasury curve.
Source: Moody's Investor Services, Bank of America Merrill Lynch

Motivating evidence from the 2008 financial crisis

- Traditional banks:
  - No withdrawals, expansion in balance sheets
  - Portfolio re-allocation from risky to safe and liquid assets
  - Rise in funding costs during (and before) the crisis



Note: Shaded areas indicate US recessions. Traditional banks refers to large domestically chartered commercial banks. Cash assets and govenment securities include vault cash, cash items in process of collection, balances due from depository institutions and Federal Reserve Banks, and liabilities of the U.S. government, U.S. government agencies and U.S. government-sponsored enterprises. Certicate of deposit and commercial paper spreads are between the secondary market rates of these securities and the Effective Federal Funds Rate. All spreads refer to 3 month maturities.
Source: Board of Governors of the Federal Reserve System, the Federal Reserve Bank of St. Louis

Roadmap

1. Motivation
2. **Overview**
3. Simple model
4. Model with liquidity shocks
5. Policy analysis
6. Conclusion

Related Literature

- Run on shadow banks: Acharya et al. (2013), Gorton & Metrick (2013), Covitz et al. (2013)
- Neglected risk: Gennaioli et al. (2013)
- Regulatory arbitrage: Ordonez (2013), Harris et al. (2014), Plantin (2015)
- Off-balance sheet exposure: Gorton & Souleles (2007), Luck & Schempp (2014), Gornicka (2016)
- Entry with support to traditional banks: Hanson et al. (2015), Chretien & Lyonnet (2017)

Contribution

1. We derive an equilibrium where banks and shadow banks coexist and interact without assuming regulatory arbitrage and/or (implicit) contractual arrangements.
    - Traditional banks have a comparative advantage in holding illiquid assets due to market discipline (instead of deposit insurance)
    - Shadow banks cause fire-sale, undermine market discipline of traditional banks
    - Market discipline may only be sustained in equilibrium with free entry of shadow banks when policy interventions offset fire sale externality
2. Demandable debt serves as market disciplining device through anticipation of withdrawal (not realization as in Diamond & Rajan, 2005)
3. Fire sale externalities have a negative impact on market discipline

Overview: Model Environment

- Financial economy with aggregate risk
  - Public signal updates probability of bad state with low asset payoff
  - Depositors may find it optimal to withdraw early after bad signal

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  - Banks cannot credibly commit to investing safe
  - Commitment cost $\tau > 0$: e.g. reporting costs, opportunity cost of avoiding opaque intermediation processes like securitization

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- Key friction: costly commitment
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  - Commitment cost $\tau > 0$: e.g. reporting costs, opportunity cost of avoiding opaque intermediation processes like securitization
- Banks optimally decide between two alternative strategies
  - Shadow banking: avoid τ, early withdrawal after bad signal
  - Traditional banking: pay τ and stay safe to avoid withdrawal
  - Free entry condition pins down relative sector sizes

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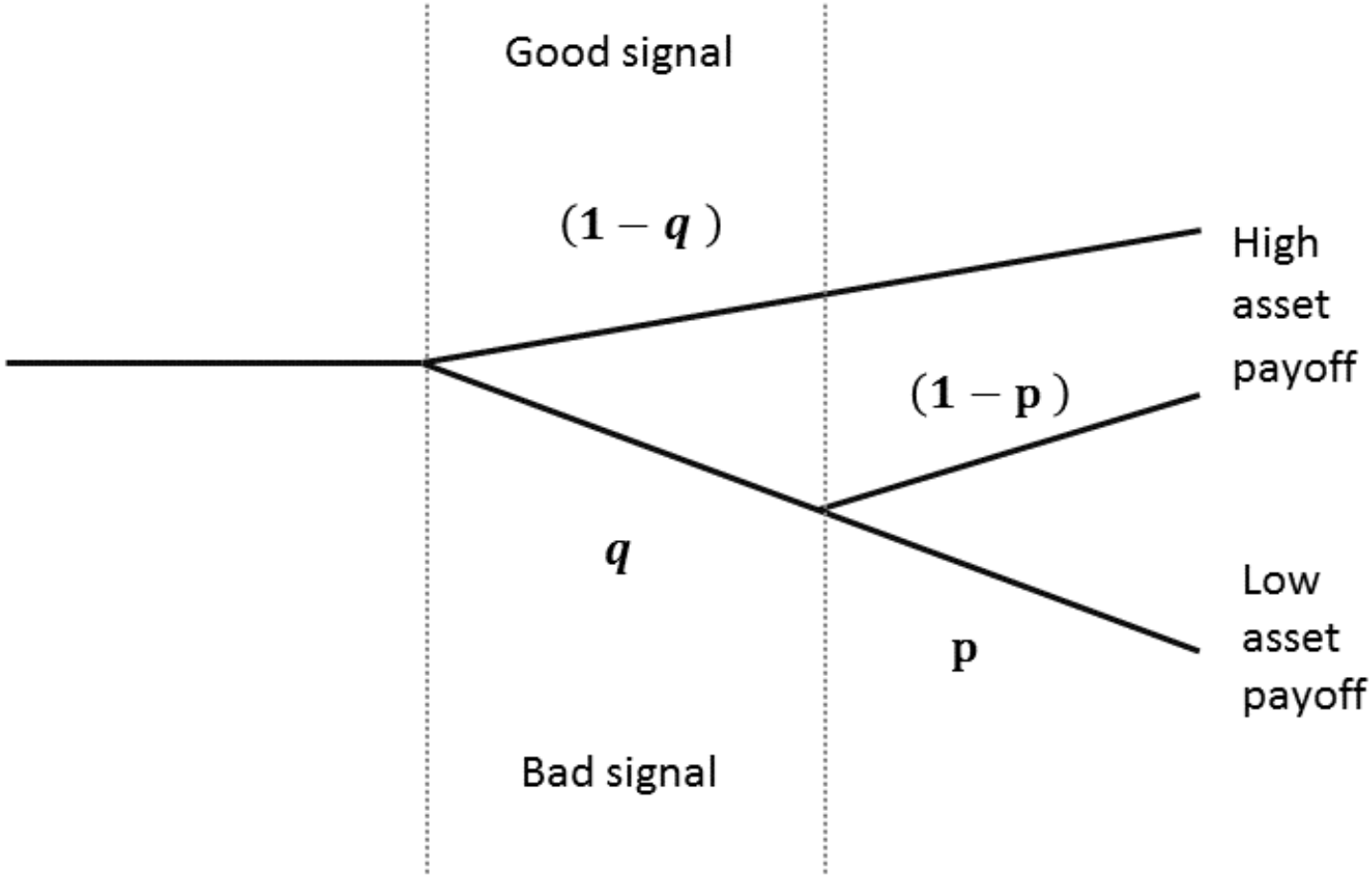
Simple Model

- No liquidity shocks (for now)
- Agents: households, banks, outside investors
- 3 periods: signal in period 2 updates probability of bad state



Assets & Portfolio Allocation (Period 1)

- Households: allocate initial endowment between
  - Safe (and liquid) asset M_1 with zero net return
  - Deposits D in banks
- Banks collect deposits and invest in
  - M_1
  - Risky (and illiquid) asset I_1 at price P_1 (Cobb Douglas, market power)

$\Rightarrow$ Budget constraint in period 1

$$M_1 + P_1 I_1 = D$$

Signal & Secondary Markets (Period 2)

- Good signal: high payoff σ_h with certainty. No fire-sale.
- Bad signal: probability p of low payoff σ_l
  - Bank's budget constraint in period 2

$$P_2 I_2 + M_2 = P_2 I_1 + M_1$$

  - Liquidation value of portfolio

$$\theta = \min\left\{\frac{P_2 I_2 + M_2}{D}, 1\right\}$$

  - Secondary markets: price depends on fire-sale discount ϕ

$$P_2 = \phi\left[(1-p)\sigma_h + p\sigma_l\right]$$

  - Fire-sale price decreases in net supply of assets by banks (Stein, 2012)

Outside investors

Asset Payoffs & Bank Solvency (Period 3)

- Bank profits contingent on asset payoff and signal

$$\Pi_{gh} = \sigma_h I_1 + M_1 - DR$$
$$\Pi_{bh} = \sigma_h I_2 + M_2 - DR$$
$$\Pi_{bl} = \max\{0, \sigma_l I_2 + M_2 - DR\}$$

- Limited liability kicks in at bad state with low asset payoff

  $\Rightarrow$ Recovery rate on deposits

$$V = \min\left\{\frac{\sigma_l I_2 + M_2}{DR}, 1\right\}$$

Household's Problem

- Risk neutral: price deposits at expected return

$$R^{SB} = 1 + \frac{q}{1-q}(1-\theta)$$

$$R^{TB} = 1 + \frac{qp(1-V)}{1-qp(1-V)}$$

- Early withdrawal decision in period 2
  - Withdraw if expected return not high enough

$$1 \leq (1-p)R + pV$$

Banking strategies

Banks choose between two distinct strategies

Shadow Banking	Traditional Banking
Risky portfolio, early withdrawal	Safe portfolio to avoid withdrawal
$E\left[\Pi^{SB}\right] = \max (1-q)(\sigma_h l_1 + M_1) - (1-q) RD$	$E\left[\Pi^{TB}\right] = \max (1-q)(\sigma_h l_1 + M_1) + q(1-p)(\sigma_h l_2 + M_2) - (1-qp)(RD + \tau)$

subject to

$$P_1 l_1 + M_1 = D \qquad \text{(B.C. in period 1)}$$

$$P_2 l_2 + M_2 = P_2 l_1 + M_1 \qquad \text{(B.C. in period 2)}$$

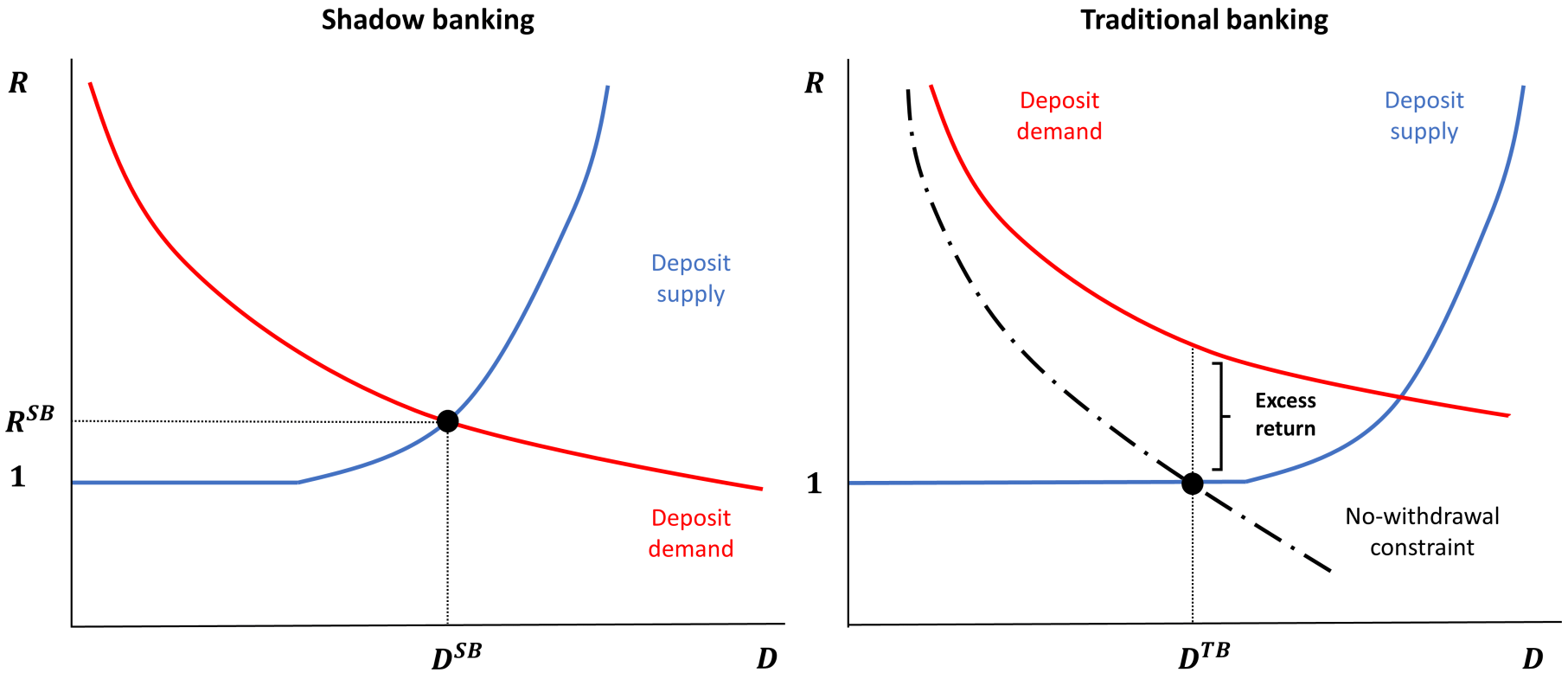
$$V \geq \frac{1}{p}\left(\frac{1}{R^{TB}} - (1-p)\right) \qquad \text{(no-withdrawal constraint for TB)}$$

- Free entry: $E\left[\Pi^{TB}\right] = E\left[\Pi^{SB}\right]$ pins share γ of shadow banks

Banking strategies and fire-sales

After bad signal:

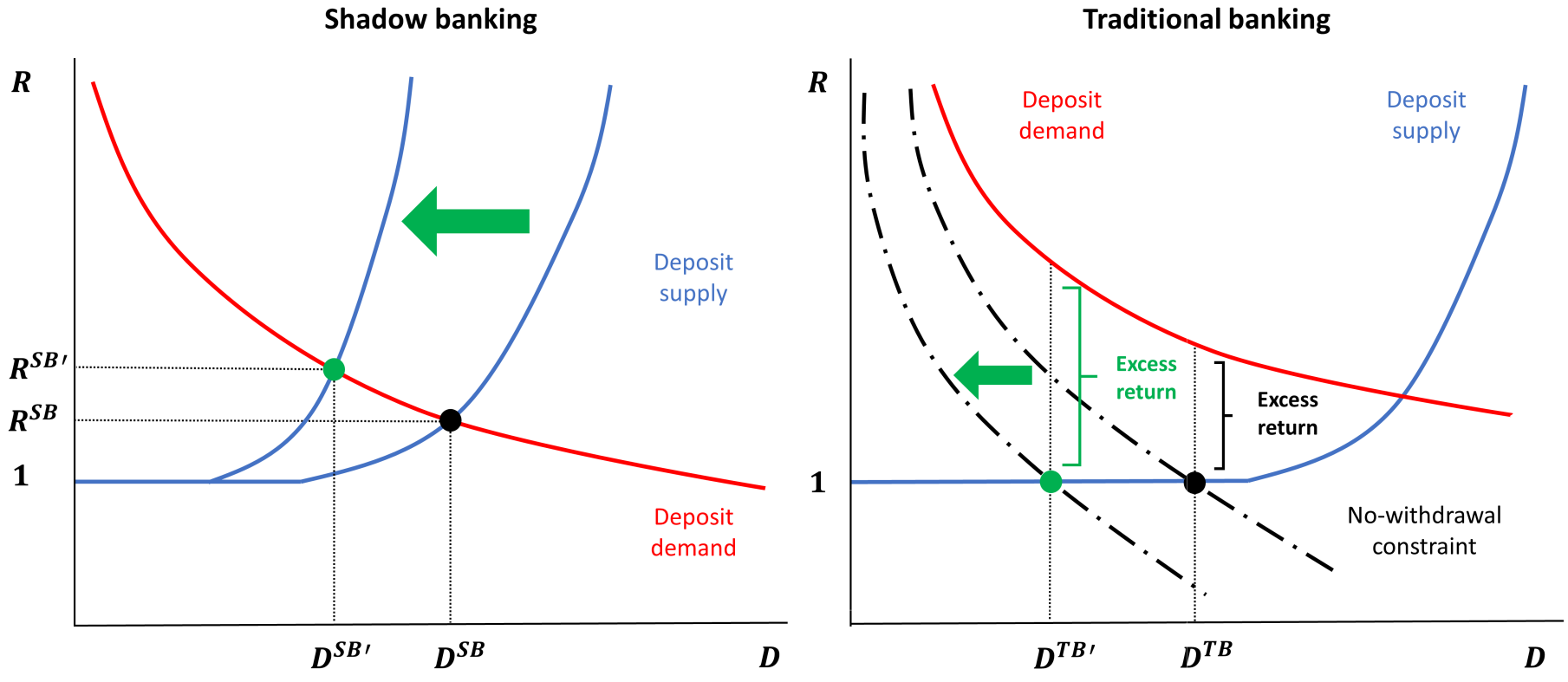
- Shadow banks: early withdrawal, liquidate assets in secondary market
- Traditional banks: re-allocate portfolio in secondary market to satisfy no-withdrawal constraint



Banking strategies and fire-sales

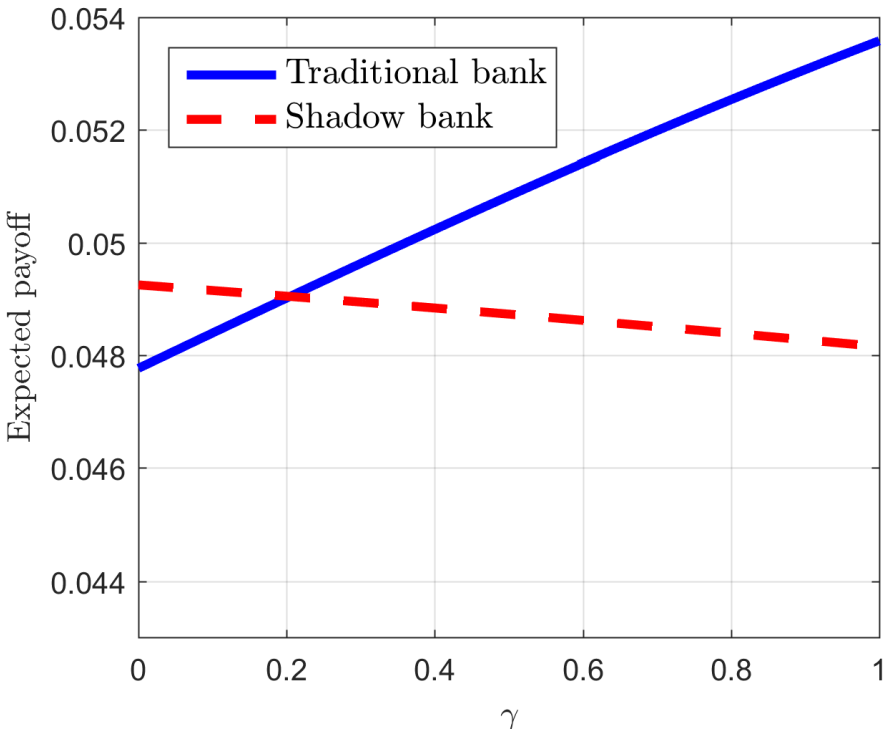
Expansion of shadow banking ($\uparrow \gamma$) exacarbates fire-sale ($\downarrow P_2$)

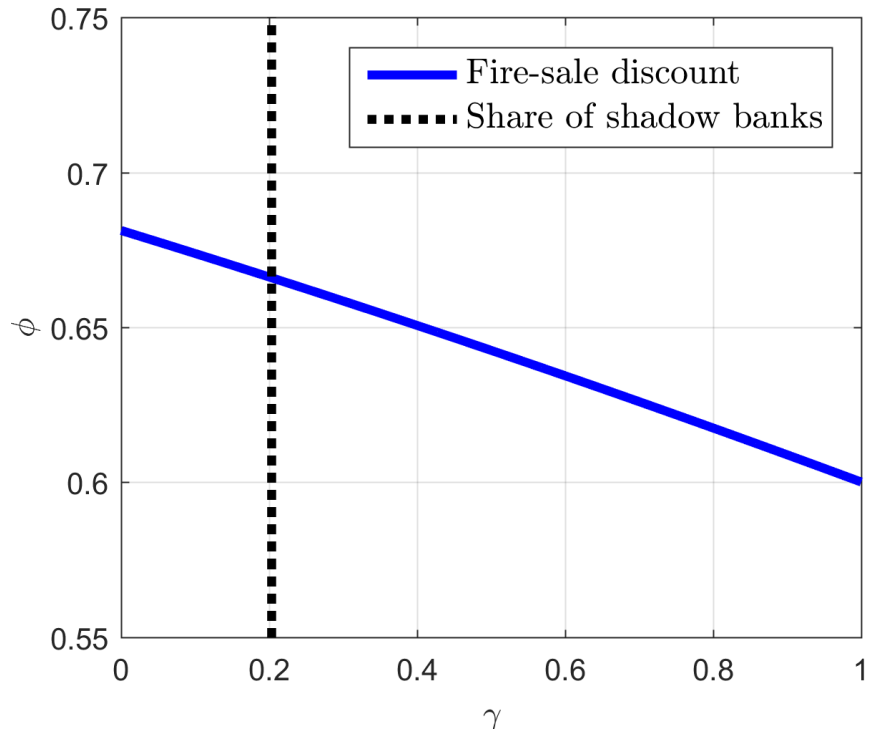
- Shadow banks: increase in borrowing costs, lower profits
- Traditional banks: tighter constraint, higher profits
- Fire-sale reduces shadow bank profits relative to traditional banks



Equilibrium

- Free entry: shadow banking expands until sufficiently deep fire-sale
- Fire-sale equilibrates shadow bank sector size at $\gamma = \gamma^*$, $E\left[\Pi^{TB}\right] = E\left[\Pi^{SB}\right]$





Market Discipline on Traditional Banks

- Recall: No-withdrawal constraint on recovery rate

$$V \geq \frac{1}{p}\left(\frac{1}{R^{TB}} - (1-p)\right)$$

  - Higher interest rates relax no-withdrawal constraint

- Virtuous cycle when there is no liquidity risk on traditional banks
  - Rise in recovery rate reduces interest rates on deposits

$$R^{TB} = 1 + \frac{qp(1-V)}{1-qp(1-V)}$$

  - Lower deposit rates tighten no-withdrawal constraint

- Traditional banks are safe and borrow at risk-free rate

$$V = R^{TB} = 1$$

  - This will change with liquidity shocks!

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Model with liquidity shocks

- Idiosyncratic liquidity shocks
  - Probability ξ of involuntary liquidation if $\theta^{TB} < 1$
  - e.g Diamond-Dybvig (1983) bank-run or need to inject cash to project
- Richer asset span
  - 3 assets: liquid, illiquid safe and illiquid risky
  - Separates liquidity from solvency

Market discipline with liquidity shocks

- Market discipline works well without shadow banking
  - Traditional banks use secondary markets to stay liquid
  - Ability to withdraw early leads to market discipline

  $\Rightarrow$ Traditional banks are safe, borrow at risk-free rate

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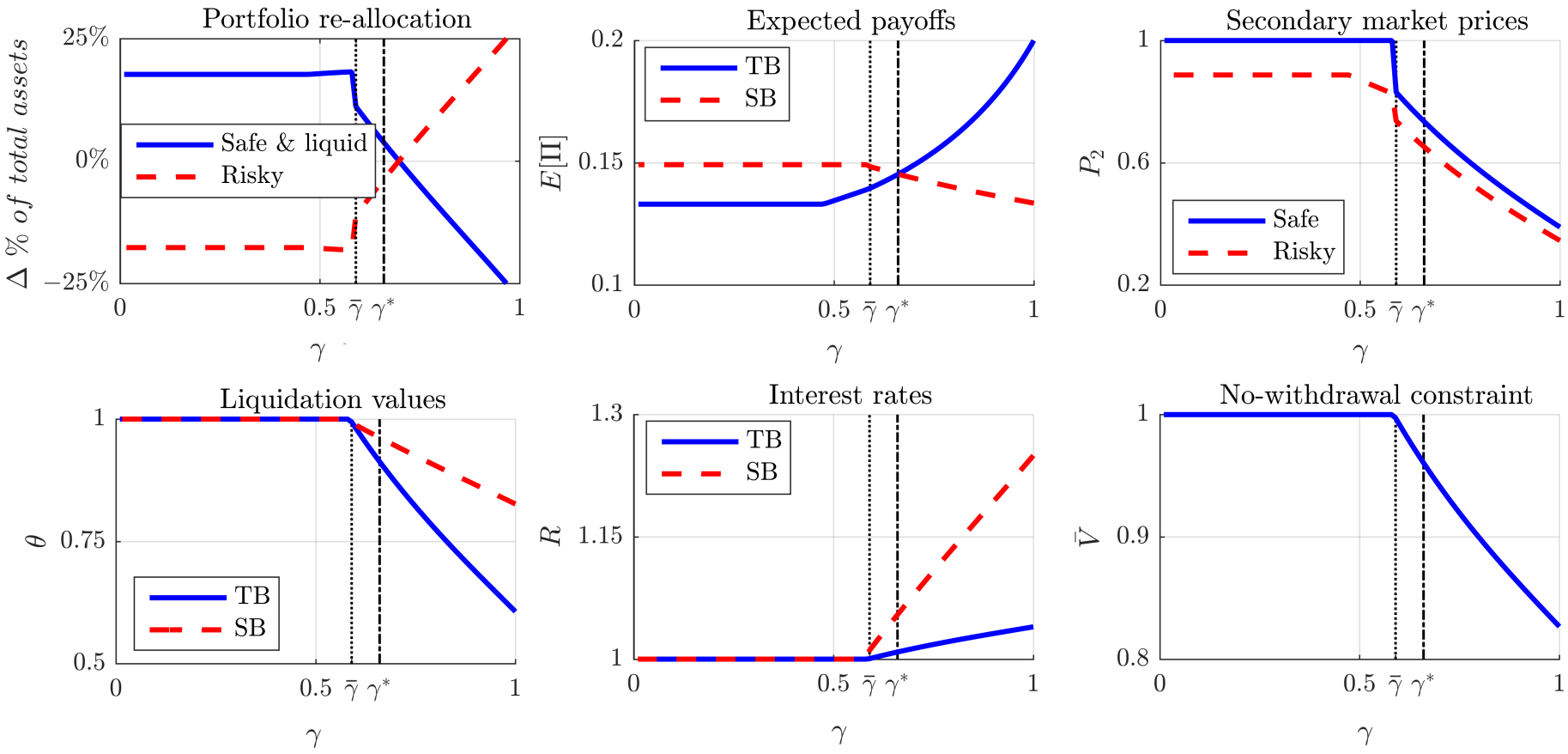
- Shadow banking undermines market discipline
  - Fire-sale: traditional banks vulnerable to liquidity shocks
  - High deposit rates to compensate for liquidity risk
  - Reduce incentives to withdraw early, relax constraint

  $\Rightarrow$ Traditional banks have higher risk-taking, solvency risk

Results

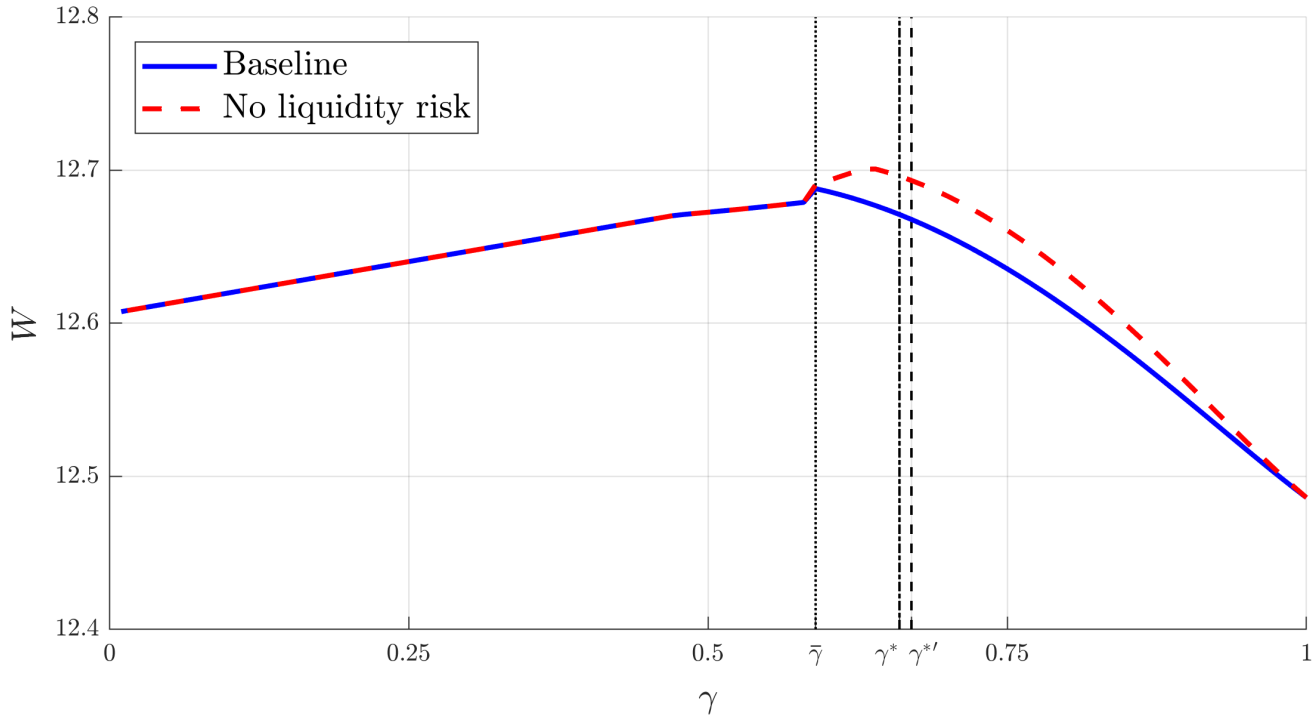
- During crisis, traditional banks re-allocate portfolio toward safe assets
- Shadow banking sector expands until it causes fire-sale
- Rise in deposit rates due to liquidity risk
- High deposit rates undermine market discipline on traditional banks



Complete Calibration

Welfare analysis

- Trade-off between financial intermediation and crowding out outside projects (Stein, 2012)
- Fire-sale externalities: shadow banking grows above social optimal
- Liquidity risk: exacerbate fire-sale externalities, reduce welfare further



Complete Calibration

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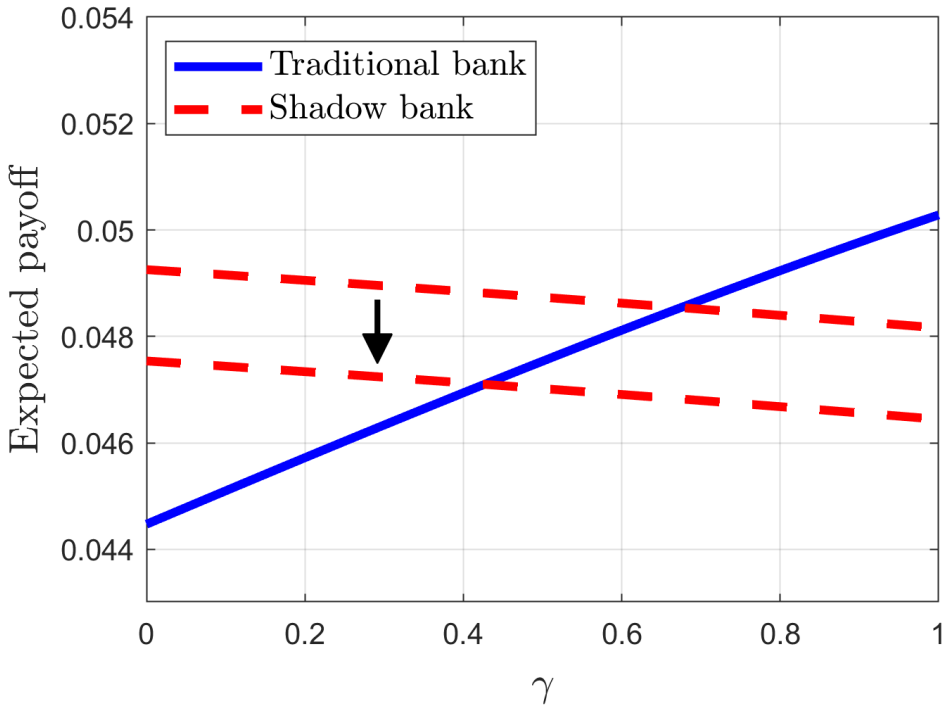
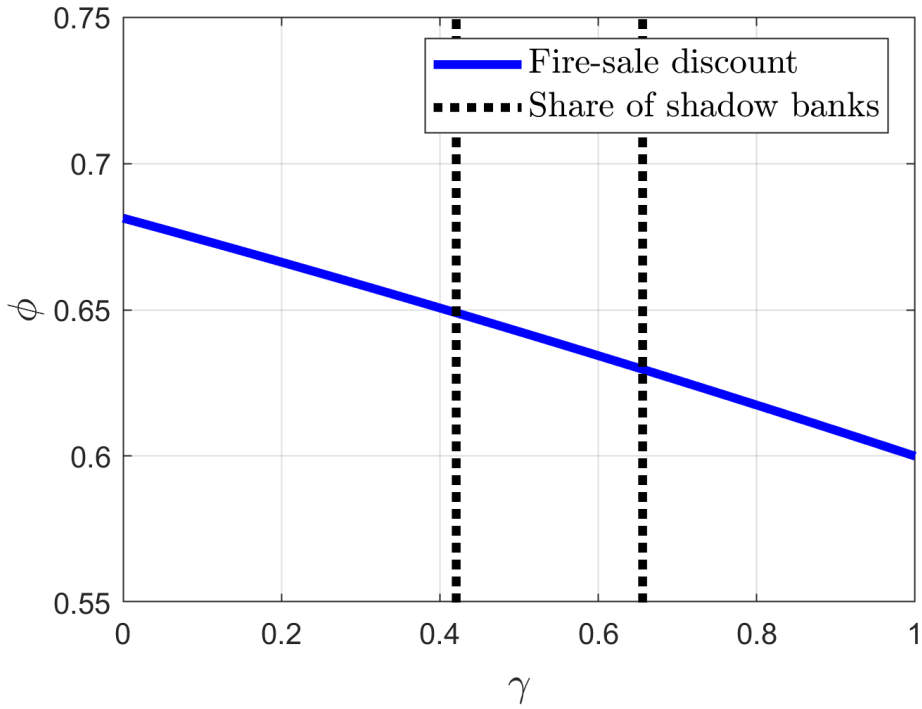
Policy analysis

1. Pigouvian tax on shadow bank profits (or transfer to traditional banks)
   - Offset fire-sale externality in entry into shadow banking
   - Reduces the size of shadow banking sector
   - Moves the equilibrium to constrained-efficient

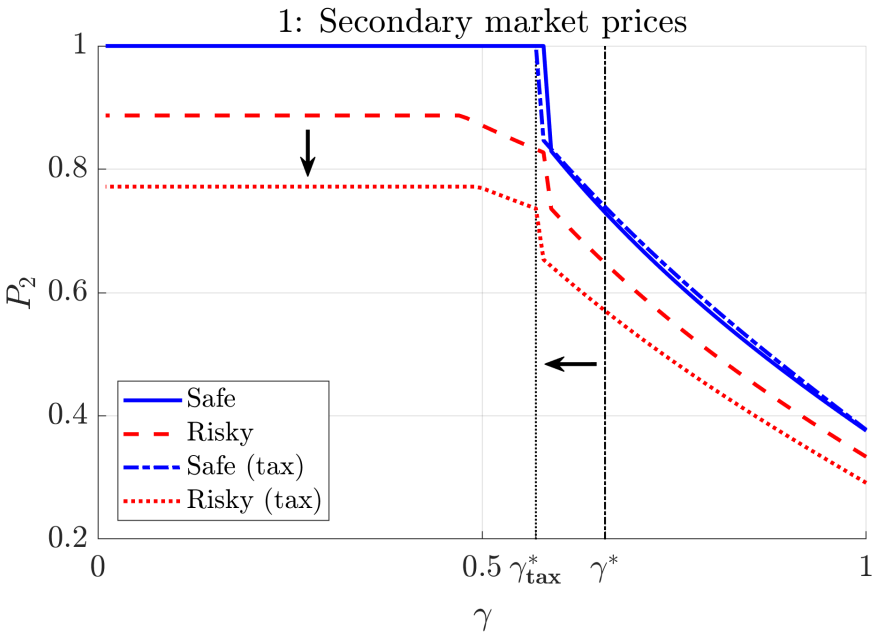


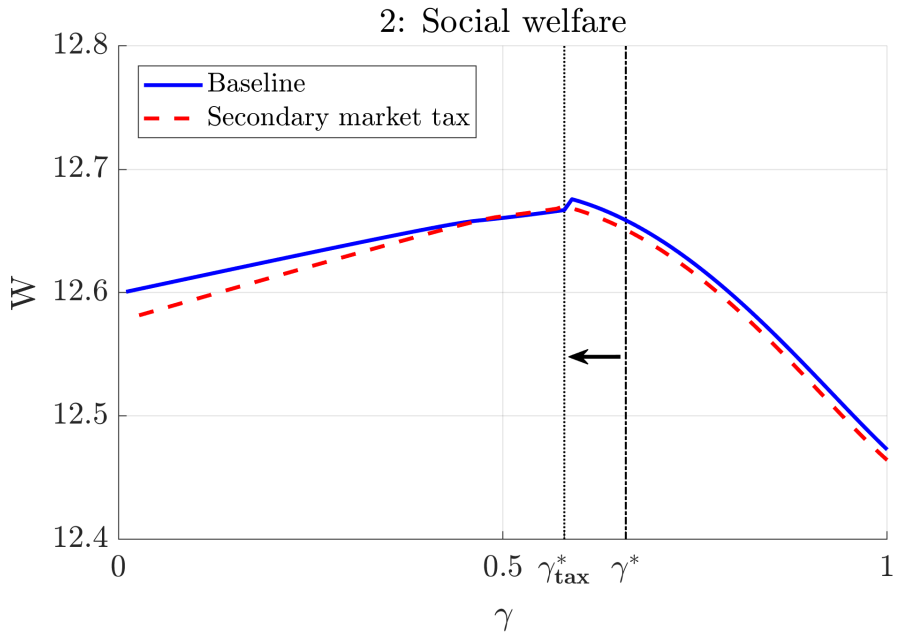


Policy analysis

2. Tax on risky assets in secondary market

- Differential tax reduces shadow bank profits, leads to exit
- Alleviate fire-sale on safe assets (risky asset fire-sale adjusts back as SB sector shrinks)
- Welfare-raising: schedule shifts down due to tax distortion but sector size closer to social optimal
- Time-inconsistency issues





Diagram

Conclusion

Model of shadow banking without regulatory arbitrage

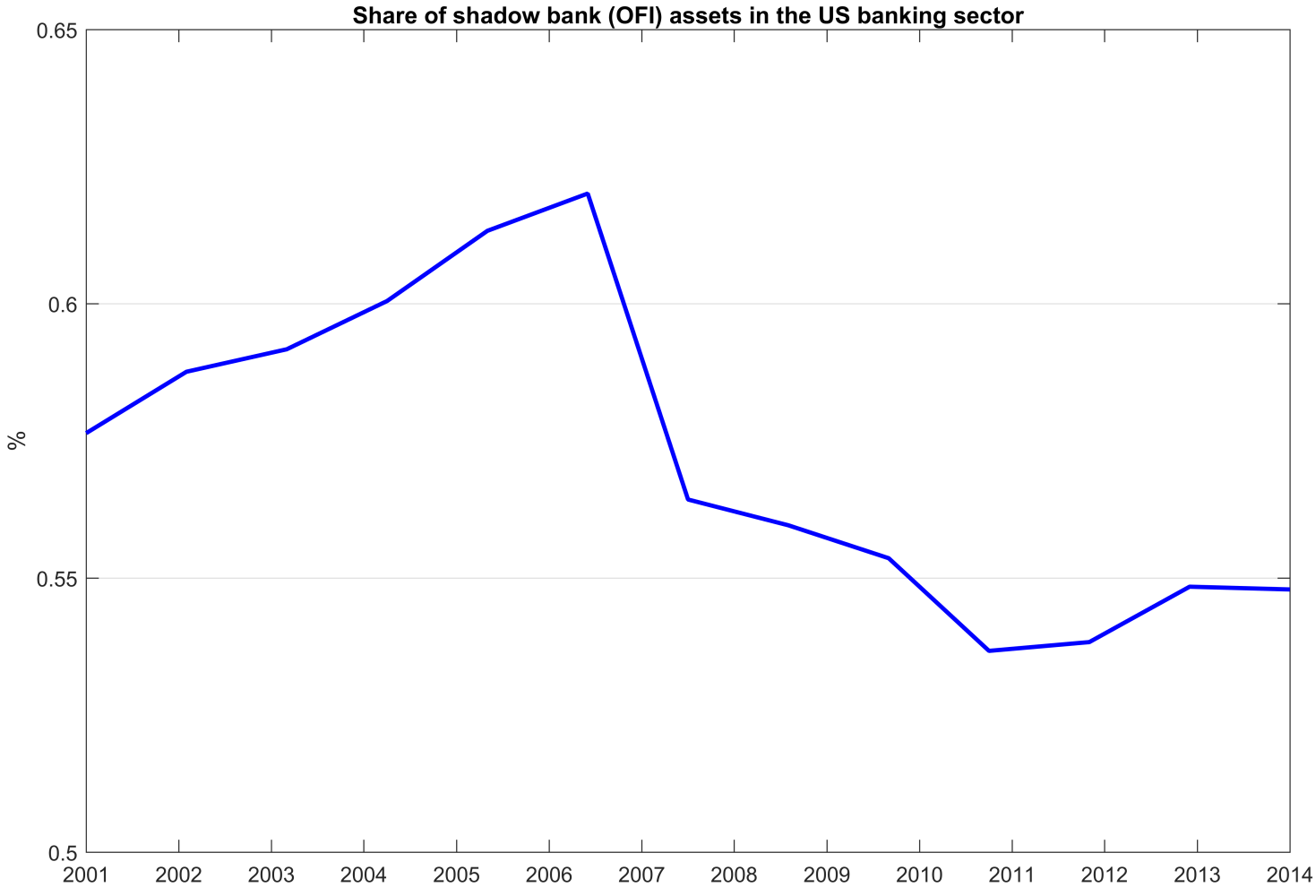
- Shadow banking as risky banking strategy with free entry
- Expands until it causes fire-sale in equilibrium
- Traditional banks become vulnerable to liquidity shocks
- Market discipline on traditional banks undermined

Framework for policy analysis

- Fire-sale externalities: in equilibrium, shadow banking exceeds social optimal size
- Pigouvian tax on shadow bank profits
- Tax on risky assets in secondary market

THANK YOU!

Share of shadow banks



Source: Financial Stability Board, Global Shadow Banking Monitoring Report 2015

Back

Outside Investor's Problem

- Endowment in period 2, allocate between
  - Outside project K with diminishing marginal return
  - Asset purchases in the secondary market

$\Rightarrow$ Downward sloping demand for secondary market purchases

$$P_2 = \phi\left[(1-p)\sigma_h + p\sigma_l\right]$$

$$\phi = g(\gamma I_1^{SB} + (1-\gamma)(I_1^{TB} - I_2^{TB}))$$

$$g'(.) < 0\ ,\ g(0) = 1$$

Back

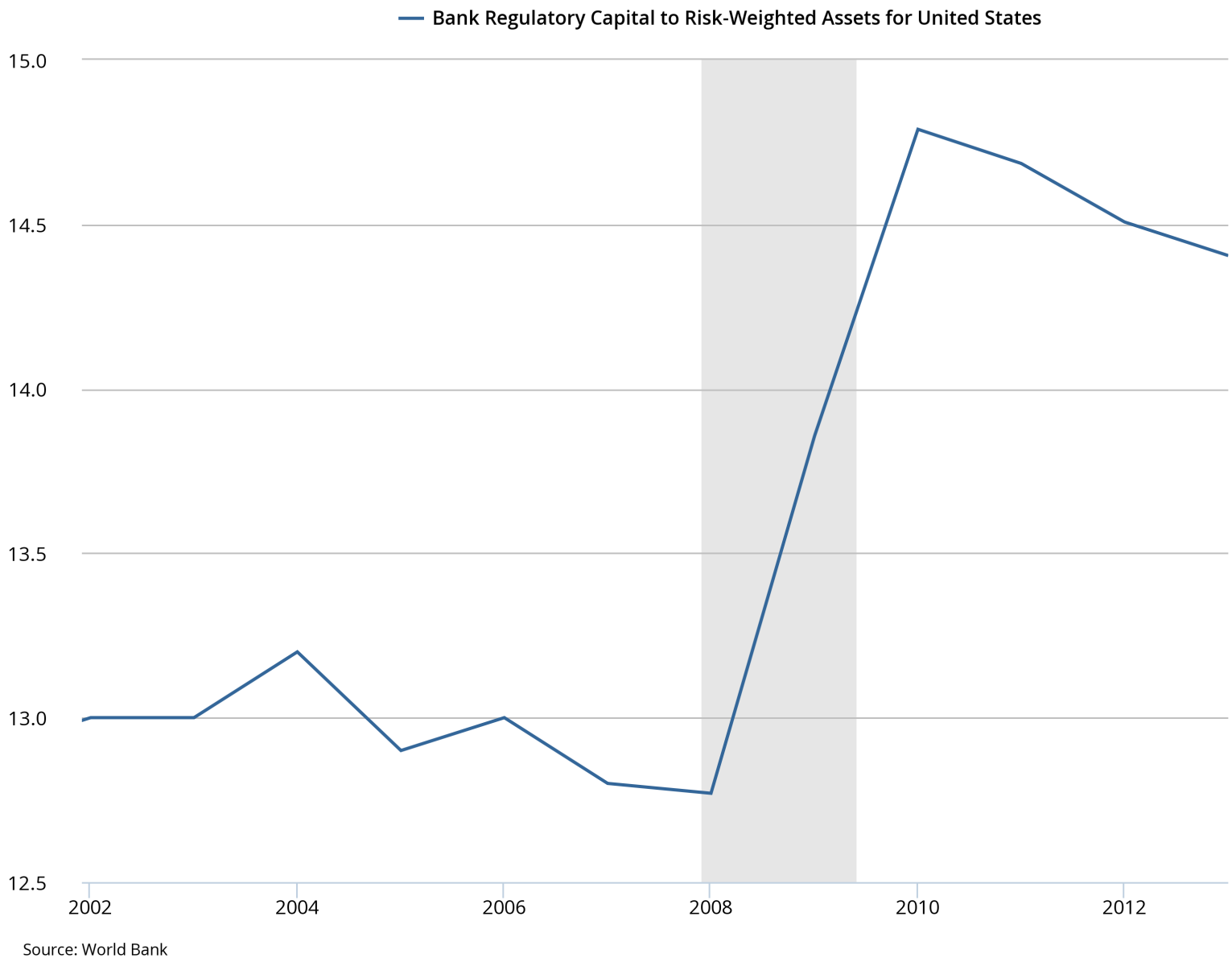
Calibration

Target US in post-war period

	Description	Value	Source
q	Prob. of bad signal	0.41	NBER
p	Prob. low payoff | bad signal	0.22	NBER
μ	Mark-up of banks	0.18	World Bank
α	Share of capital income	0.33	Cobb-Douglas
A	Productivity	1	-
E	Outside investor endowment	2.80	Moody's, Fed Board
z	Outside investment parameter	10.00	Moody's, Fed Board
ξ	Liquidity shock prob.	0.15	St. Louis Fed
τ	Screening cost	0.11	FSB (2017)

Back

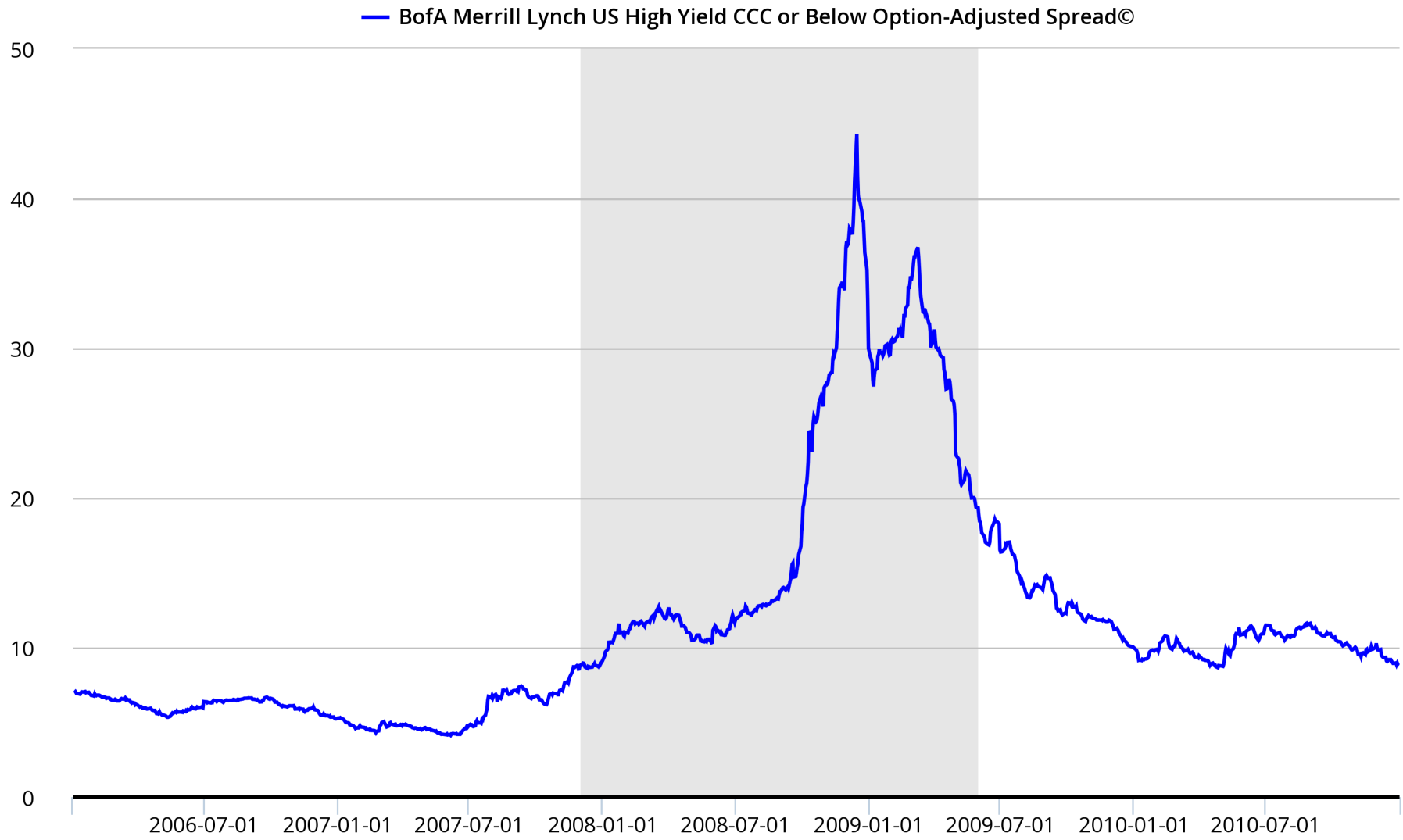
Bank capital / RWA



Source: Board of Governors of the Federal Reserve System

Back

Spreads of high yield assets



Source: BofA Merrill Lynch

Back

Banking strategies with liquidity shocks

Banks choose between two distinct strategies

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Risky portfolio, early liquidation	Safe portfolio to avoid withdrawal
$E\left[\Pi^{SB}\right] = \max (1-q)(\sigma_h l_1 + M_1)$ $-(1-q)RD$	$E\left[\Pi^{TB}\right] = \max (1-q)(\sigma_h l_1 + M_1)$ $+q(1-\xi)(1-p)(\sigma_h l_2 + M_2)$ $-(1-q+q(1-p)(1-\xi))(RD-$

subject to

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$$V \geq \bar{V} \qquad \text{(no-withdrawal constraint for TB)}$$

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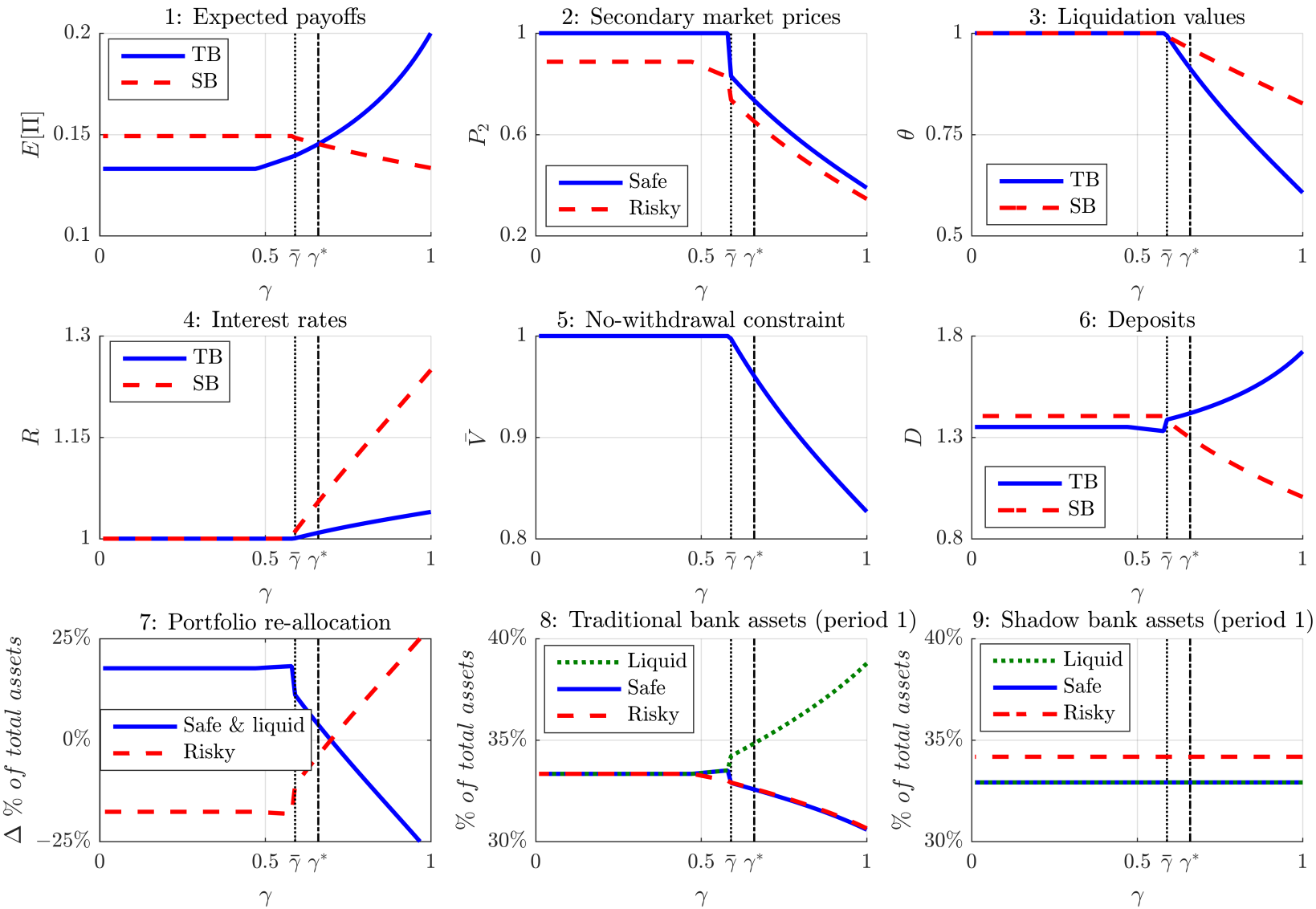
Complete results

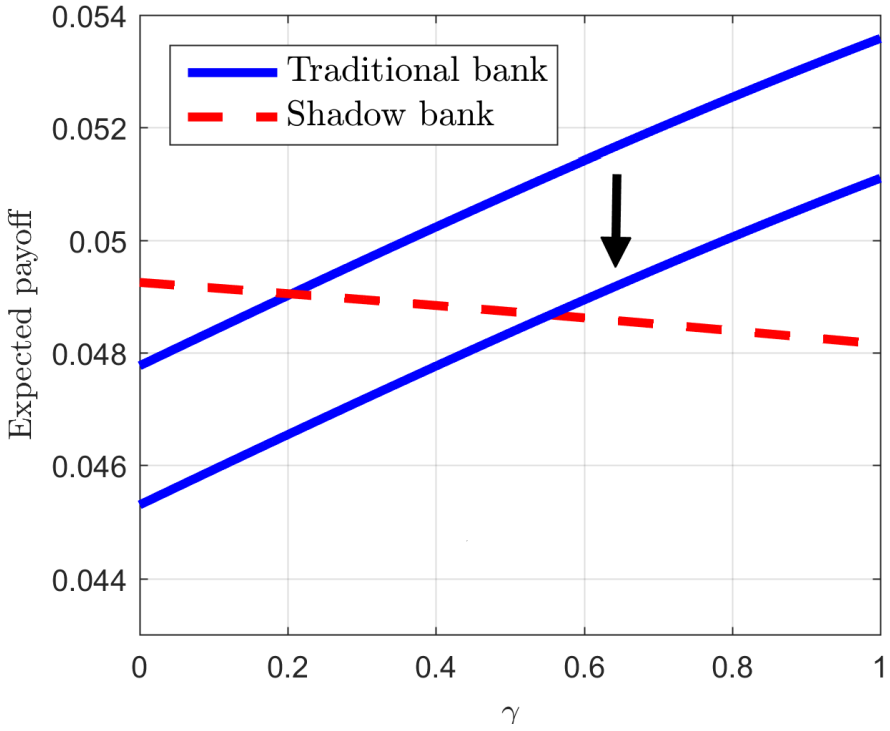


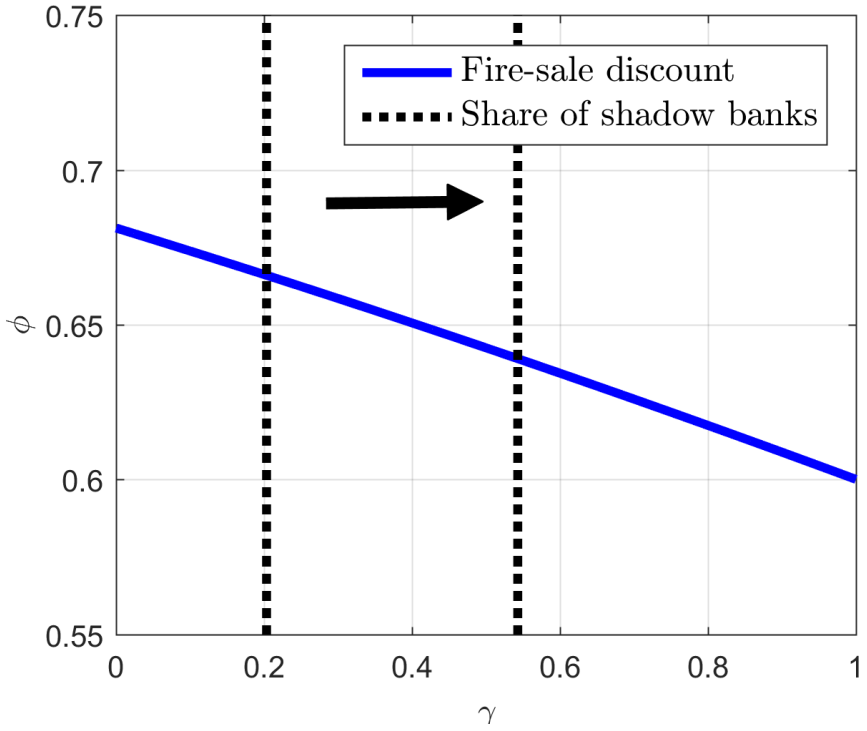
Back

Comparative statics: Rise in screening costs

Fall in traditional bank profits

Migration to shadow banking, deeper fire sale

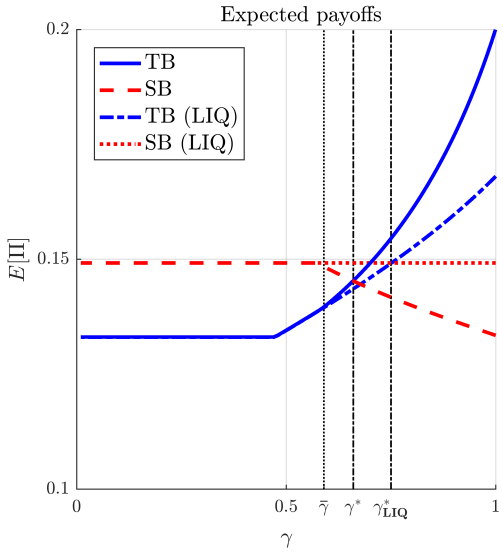


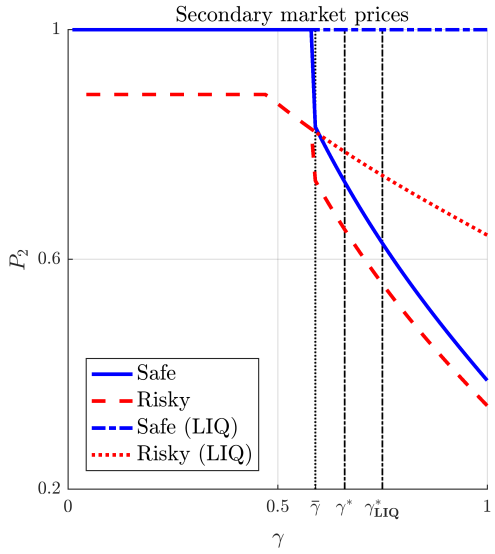


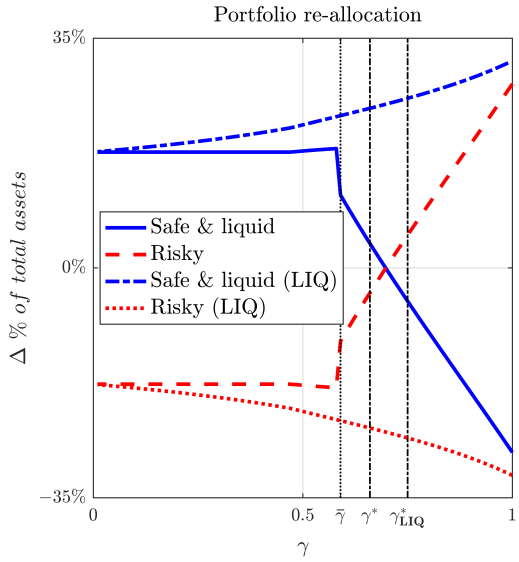
Liquidity support and bank regulation

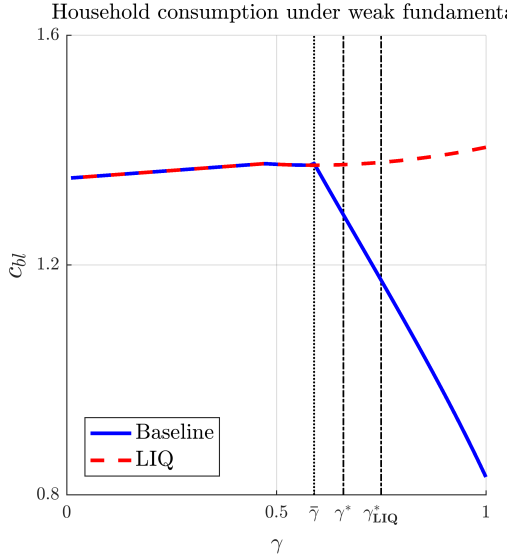
Traditional banks: use funds to buy safe assets

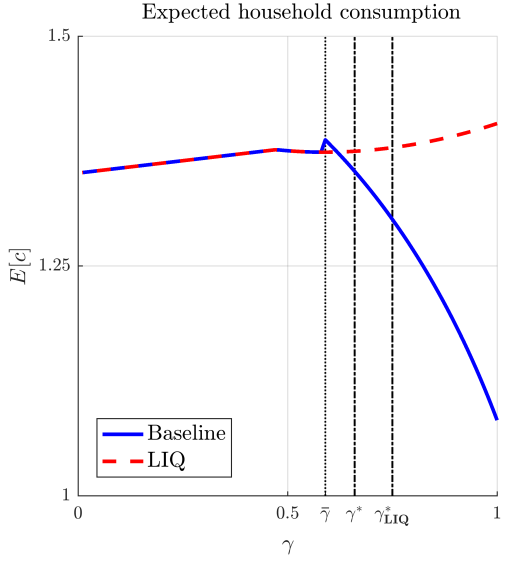
No fire-sale on safe assets. Reallocate portfolio by larger amount



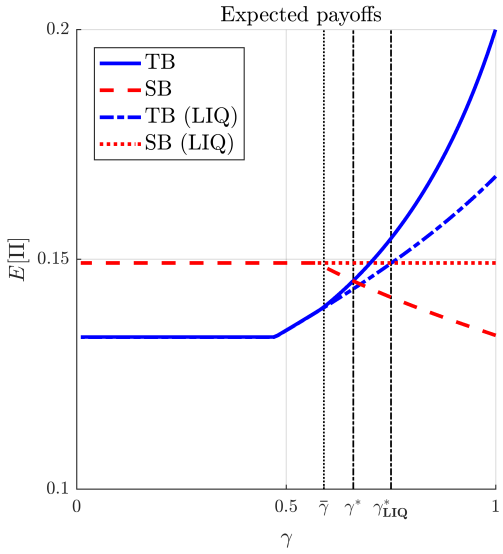
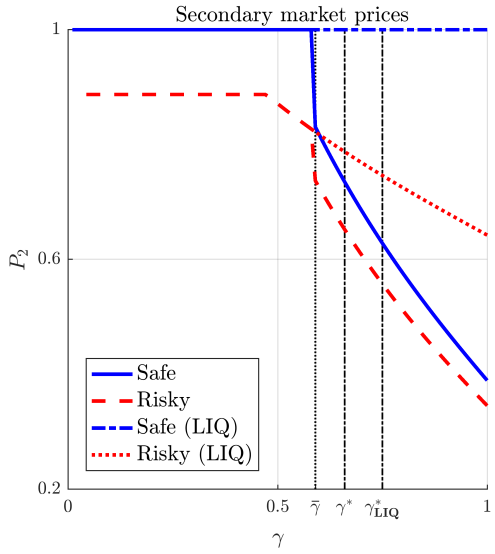
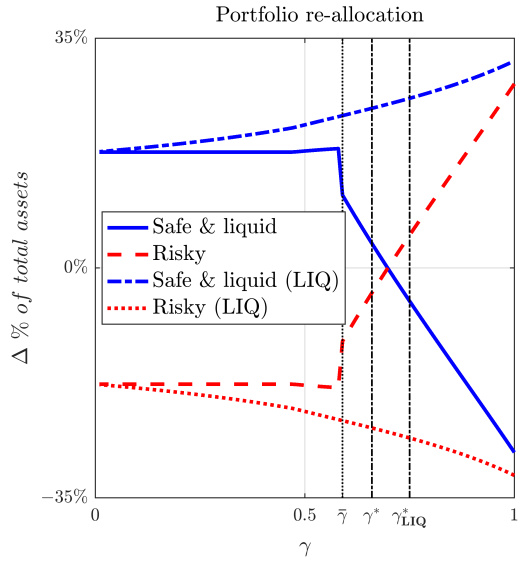
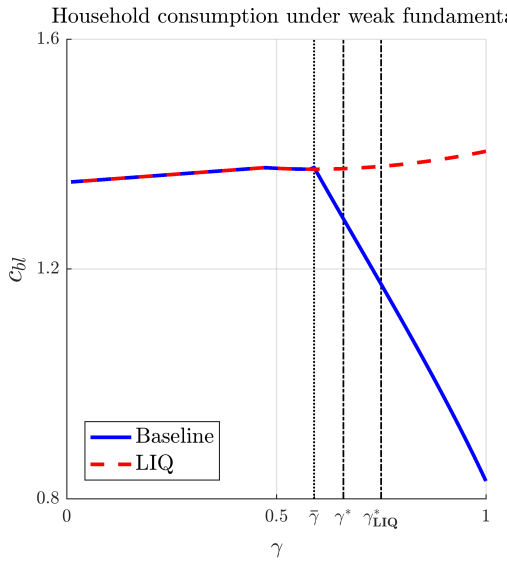
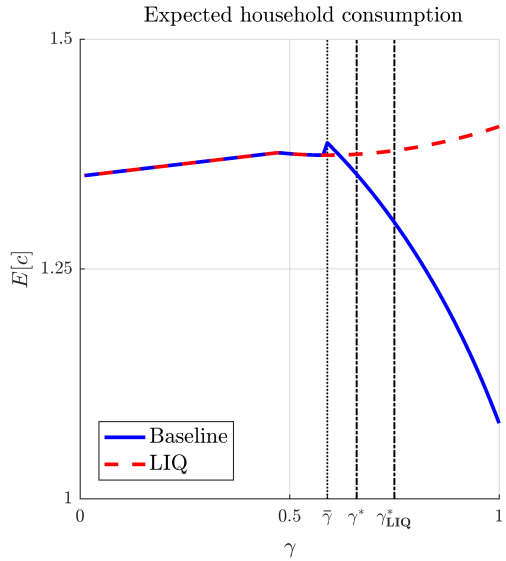








Liquidity support and bank regulation

Decline in fire-sale leads to expansion in shadow banking

Overall positive effect on financial stability