Bankruptcy Exemption of Repo Markets: Too Much Today for Too Little Tomorrow?

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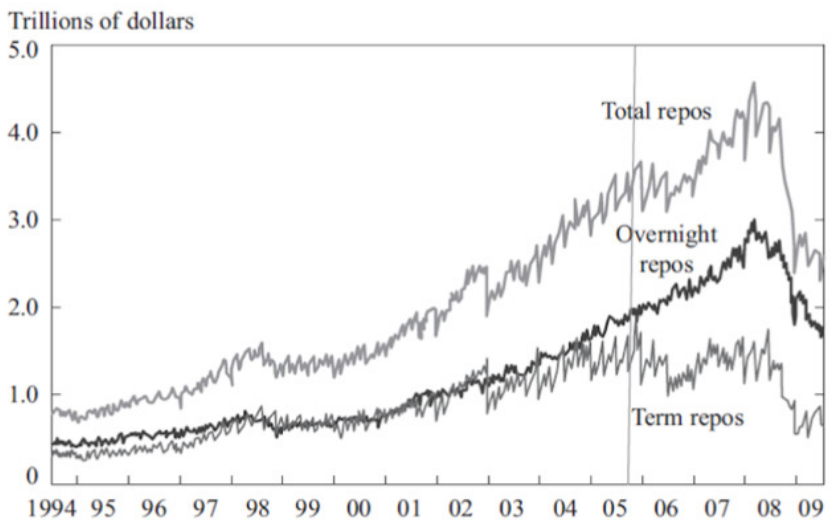
Repurchase Agreement

- Repurchase agreement is a short-term contract for lending based on financial collateral
- Average daily outstanding for repo and reverse-repo in 2019 was \$2.5 Trillion and \$2 Trillion, respectively (SIFMA report)
- Stress during the GFC was seen mostly in risky asset classes such as MBS [Gorton and Metrick, 2012]
- Recent stress in repo markets also witnessed in Treasury market repo; as in Sep 2019 and Mar 2020 [Copeland et al., 2021]



Growth in the Repo Market [Adrian and Shin, 2010]

◂ Related Literature

Role of Safe Harbor Provisions?

- Repo contracts at present have access to "safe harbor" or bankruptcy-exemption provisions
- Safe harbor provision
  - Repo transactions are exempt from automatic stay in bankruptcy
  - All repo transactions can be settled with immediacy (i.e., repo financiers can exercise property rights over the underlying collateral and liquidate assets in case the borrower cannot repurchase)
  - Started with Treasuries and Agency securities, and extended to non-Agency MBS in 2005
- Safe harbor increases ex-ante lending while increasing the likelihood of ex-post fire sales (Duffie and Skeel [2012], Acharya and Öncü [2014])
- **This paper**: Highlights inefficiency of safe harbor provisions using a general equilibrium framework

Main Argument

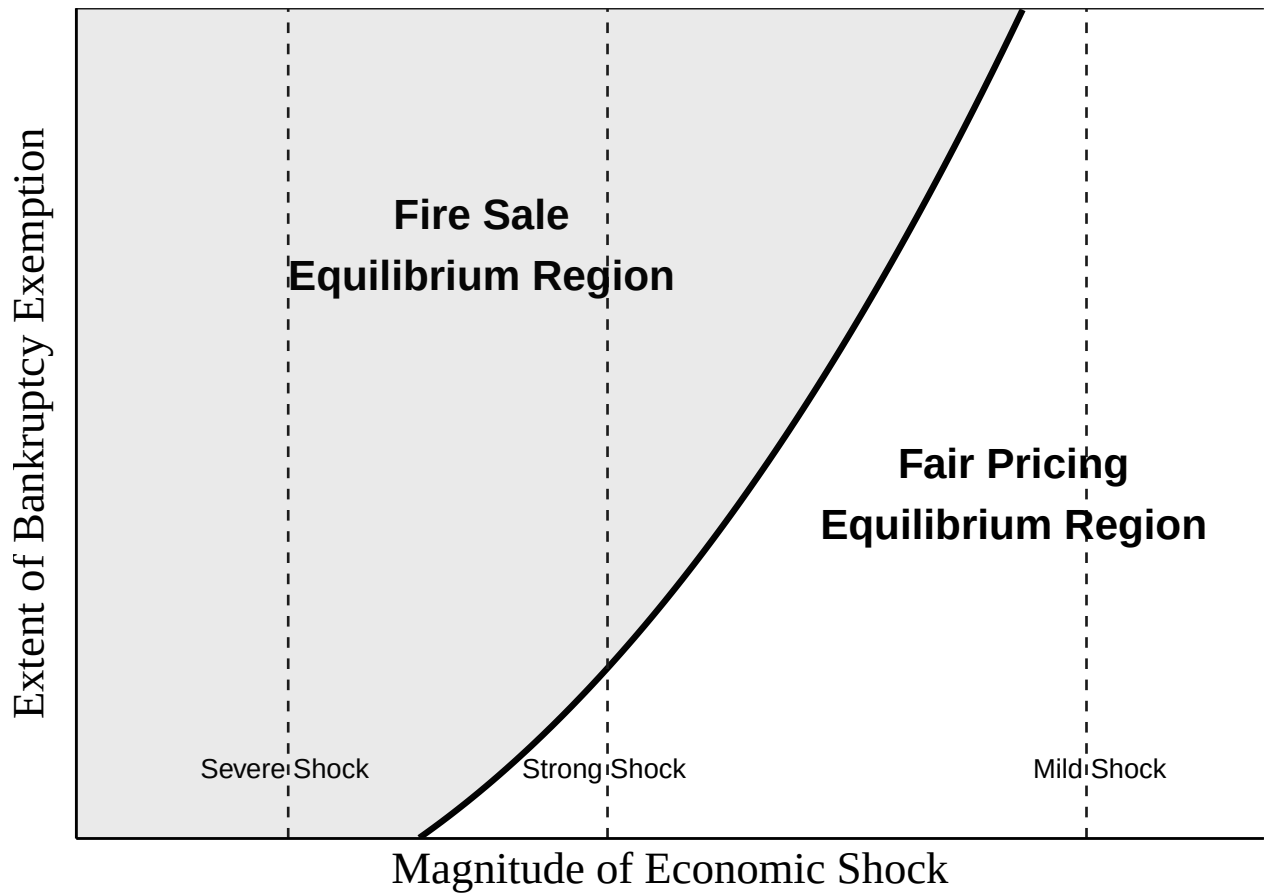
- In partial equilibrium, granting liquidation rights to lenders enables financial firms to increase leverage and originate more assets

- In general equilibrium
  - Leverage buildup can lead to inefficient fire sales after an adverse economic shock
  - Liquidity-surplus firms invest in buying financial assets in fire sales at the expense of new originations
  - Bankruptcy exemption amplifies leverage buildup (ex-ante) and underinvestment in new loans (ex-post)

- Fire-sale and reduced intermediation effects (after an adverse economic shock) can dominate the initial asset origination effect

Main Result

Economic Shock	Fire Sale Effects	Optimal Bankruptcy
Mild	Do not arise	Full Exemption
Strong	Small	Partial Exemption
Severe	Large	Automatic Stay



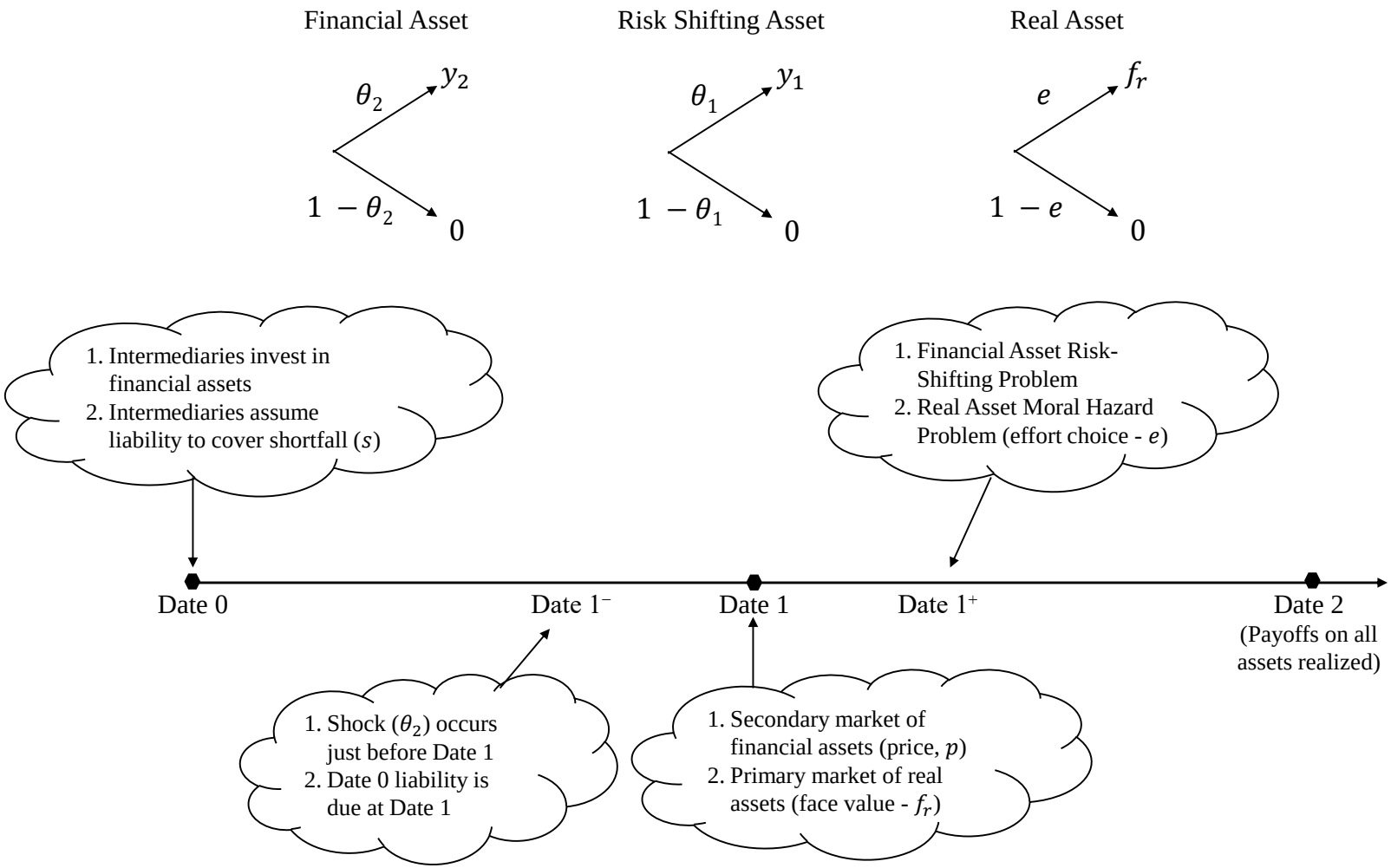
Model Setup

- Two-period, three-date world (Date 0, 1, and 2)

- **Firms**: There is a continuum of financial firms with differing amount of investment shortfall (s) at Date 0
  - Shortfall is financed using short-term repo contracts payable at Date 1 (can be rolled over to Date 2)

- **Assets**: There are three assets in the economy
  1. Financial assets (e.g., legacy loans)
     - ⋆ Can be pledged at Date 0 to raise repo financing
     - ⋆ Risk-shifting alternative (never used in equilibrium, but creates rollover risk)
  2. Real assets (e.g., new mortgages or small-business loans)
     - ⋆ Cannot be pledged to raise capital

Asset Payoffs and Timeline



▸ Relation with AV(2011)

Ex-post Model at Date 1: Optimization Behaviour of Agents

- Lenders fund only up to the debt capacity of the asset given by $\rho^* = \underbrace{\theta_2 y_2 - k_1}_{\text{pledgeable return}}$ *where* $k_1 = \frac{\theta_2 \theta_1 (y_1 - y_2)}{\theta_2 - \theta_1}$ (Note: $\theta_2 \uparrow \Rightarrow \rho^* \uparrow, k_1 \downarrow$)

- Households choose optimal effort level (e^*) given quadratic effort aversion $e^* = \frac{1}{\gamma}(R - f_r)$ (Note: $f_r \uparrow \Rightarrow e^* \downarrow$)

- Constrained firms ($\rho > \rho^*$) sell assets: $\underbrace{q}_{\text{Pr[liquidation]}} \times \underbrace{min\left[\frac{\rho - \rho^*}{p - \rho^*}, 1\right]}_{\text{fraction } \alpha \text{ sold at liquidation}}$

- Surplus firms ($\rho \leq \rho^*$) allocate between financial assets and real assets ($\bar{\beta}$)

◂ Rationality Constraints

Ex-post Model at Date 1: Equilibrium Solution

- Market clearing price obtains by enforcing financial market clearing

$$p\left(\overline{\beta},\theta_2\right)=\rho^*+\underbrace{\frac{1}{q}\int_{\rho_{min}}^{p}G(\rho)\,d\rho}_{\text{demand effect}}-\underbrace{\frac{1-q}{q}\int_{\rho^*}^{p}G(\rho)\,d\rho}_{\text{supply effect}}-\underbrace{\frac{\overline{\beta}}{q}}_{\text{substitution}}$$

- Equilibrium returns on financial and real asset prevent cross market arbitrage

$$\frac{k_1}{p-\rho^*}=ef_r\leftrightarrow\overline{\beta}>0\quad and\quad \frac{k_1}{p-\rho^*}>ef_r\leftrightarrow\overline{\beta}=0$$

Equilibrium Regions

Propositions 1 & 2

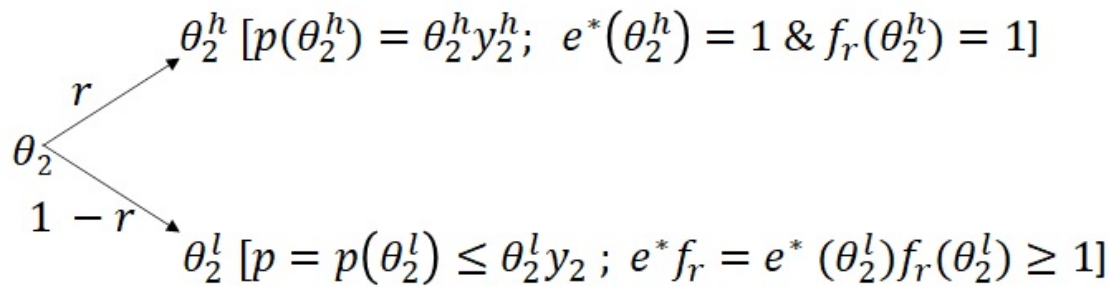
- For a given shock (θ_2), there are up-to four equilibrium regions depending on bankruptcy exemption parameter (q)
  - As bankruptcy exemption (q) increases, equilibrium goes from Fair Pricing region to the Fire Sale region
  - Fair Pricing $\rightarrow$ Price Discrimination $\rightarrow$ Liquidity Crunch $\rightarrow$ Credit Crunch

Bankruptcy			Financial Asset	Real Asset	
Exemption (q)	Equilibrium		Pricing (p)	Supply ($\overline{\beta}$)	Pricing (f_r)
Minimum	**Fair Pricing**		Fair Value	Fully Satiated	Fair Value
Small		Price Discrimination	Discount	Fully Satiated	Premium
Medium	**Fire Sale**	Liquidity Crunch	Discount	Unmet Demand	Premium
High		Credit Crunch	Discount	Shut Down	Shut Down

▸ Fair Pricing ▸ Price Discrimination ▸ Liquidity Crunch ▸ Credit Crunch

Ex-ante Model at Date 0

- Good state ($\theta_2 = \theta_2^h$, Asset Payoff $= y_2^h > y_1 > y_2$, $\gamma = 0$, $\bar{\beta} = \mathscr{B}$)
- Bad state ($\theta_2 = \theta_2^l < \theta_2^h$, Asset Payoff $= y_2 < y_1 < y_2^h$, $\gamma > 0$, $\bar{\beta} \leq \mathscr{B}$)



- Investment shortfall of firms (s) is uniformly distributed as $U[s_{min}, s_{max}]$
  - Lenders finance firms having shortfalls up to $\hat{s}(\theta_2^l, q)$ – considering the payoff potential of the asset for a given adverse shock (θ_2^l) and the possibility of write-down $(1 - q)$
  - $\hat{s}(\theta_2^l, q) = r\theta_2^h y_2^h + (1 - r)\bar{p} \leq s_{max}$ where $\bar{p} = qp(\theta_2^l) + [1 - q]\rho^*(\theta_2^l)$
- **Key Feature of Ex-Ante Model: Distribution of debt at Date 0 (i.e., $g(\rho)$) is endogenously determined**

▸ Payoff Potential ▸ Shortfall Financing ▸ Endogenous Debt Distribution

Effect of Bankruptcy Exemption, q

Proposition 3

Equilibrium Region	$\frac{dp}{dq}$	$\frac{d\bar{p}}{dq}$	$\frac{df_r}{dq}$	$\frac{d\bar{\beta}}{dq}$	**Details**
Price Discrimination	$-$	$-$	$+$	0	▸ Details-PD
Liquidity Crunch	0	$+$	0	$-$	▸ Details-LC
Credit Crunch	$-$	$-$	NA	NA	▸ Details-CC

▸ Equilibrium Regions ▸ Equilibrium Characteristics

Surplus Creation

- Surplus generated by the real sector per unit of investment is

$$S_r\left(q;\theta_2^I\right) = \underbrace{e^* R - \frac{1}{2}\gamma(e^*)^2}_{\text{project return net of cost of effort}}$$

- **Expected Date 1 Surplus** is given by

$$S_{D1}\left(q;\theta_2^I\right) = r\mathscr{B}R + (1-r)\,\overline{\beta}\left(q;\theta_2^I\right) S_r\left(q;\theta_2^I\right)$$

- **Expected Date 0 Surplus** is given by

$$S_{D0}\left(q;\theta_2^I\right) = \int_{s_{min}}^{\hat{s}} \underbrace{E_{\theta_2}\left[\theta_2 y_2 - s\right]}_{\text{expected NPV}} dH(s)$$

- **Total Surplus** is the sum of expected Date 1 and Date 0 surplus, i.e.,

$$S_{Total}(q;\theta_2^I) = S_{D1}(q;\theta_2^I) + S_{D0}(q;\theta_2^I)$$

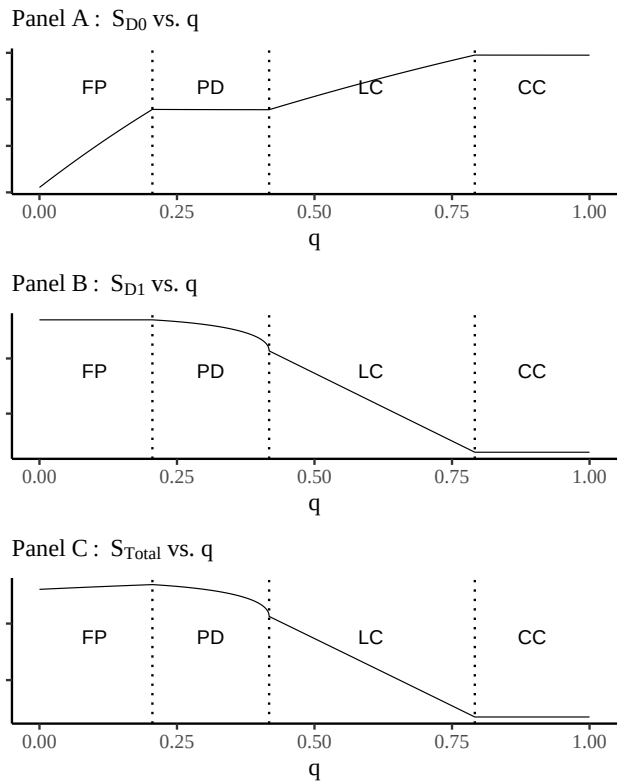
Optimal Bankruptcy Exemption

Proposition 4

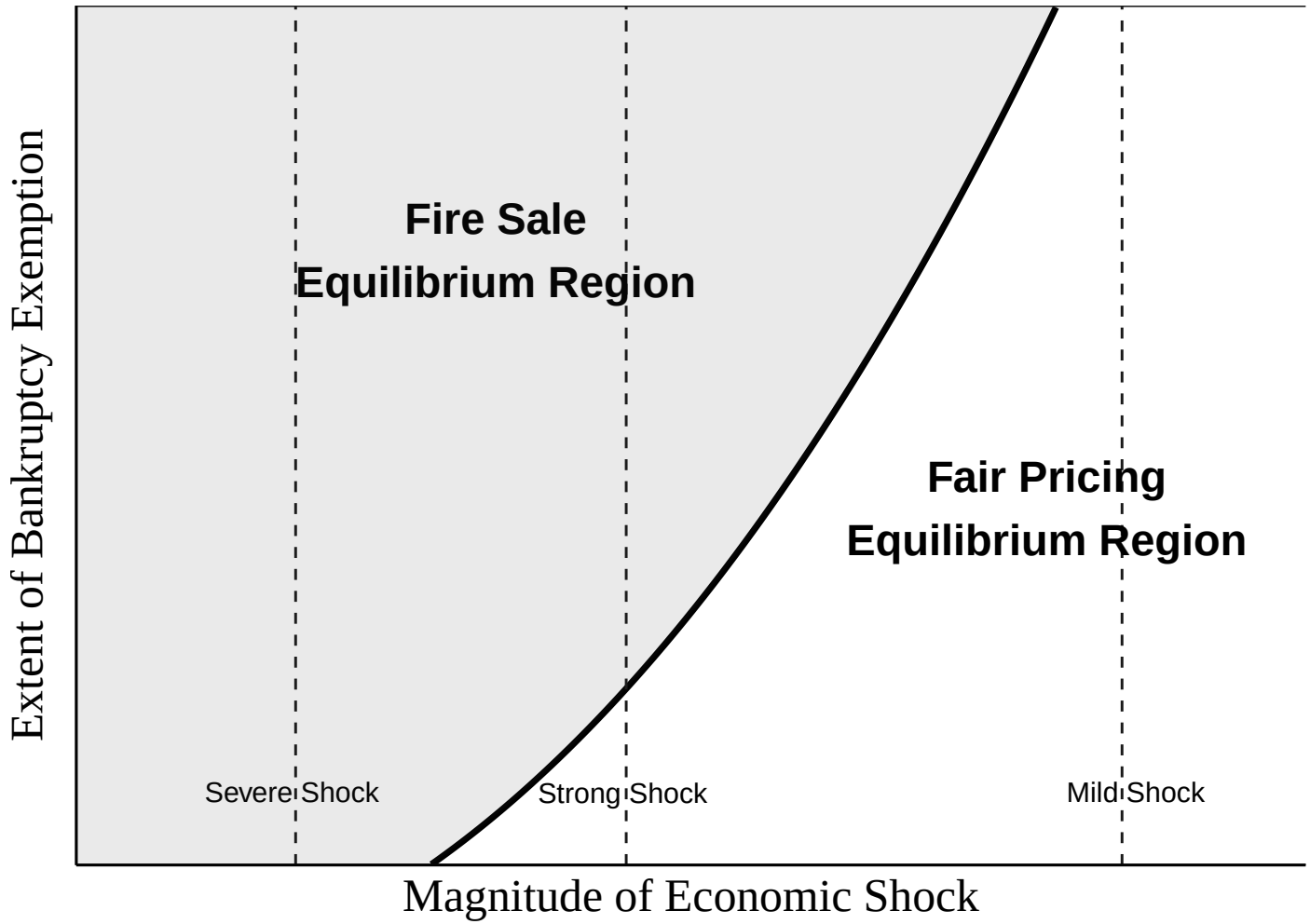
For a given θ_2^l, optimal bankruptcy exemption (q^{opt}) that maximizes total surplus (S_{Total}) is at the border of Fair Pricing and Fire Sale equilibrium regions

Equilibrium Region	$\frac{dS_{D0}}{dq}$	$\frac{dS_{D1}}{dq}$	$\frac{dS_{Total}}{dq}$
Fair Pricing	$+$	0	$+$
Price Discrimination	$-$	$-$	$-$
Liquidity Crunch	$+$	$-$	$-$
Credit Crunch	$-$	0	$-$

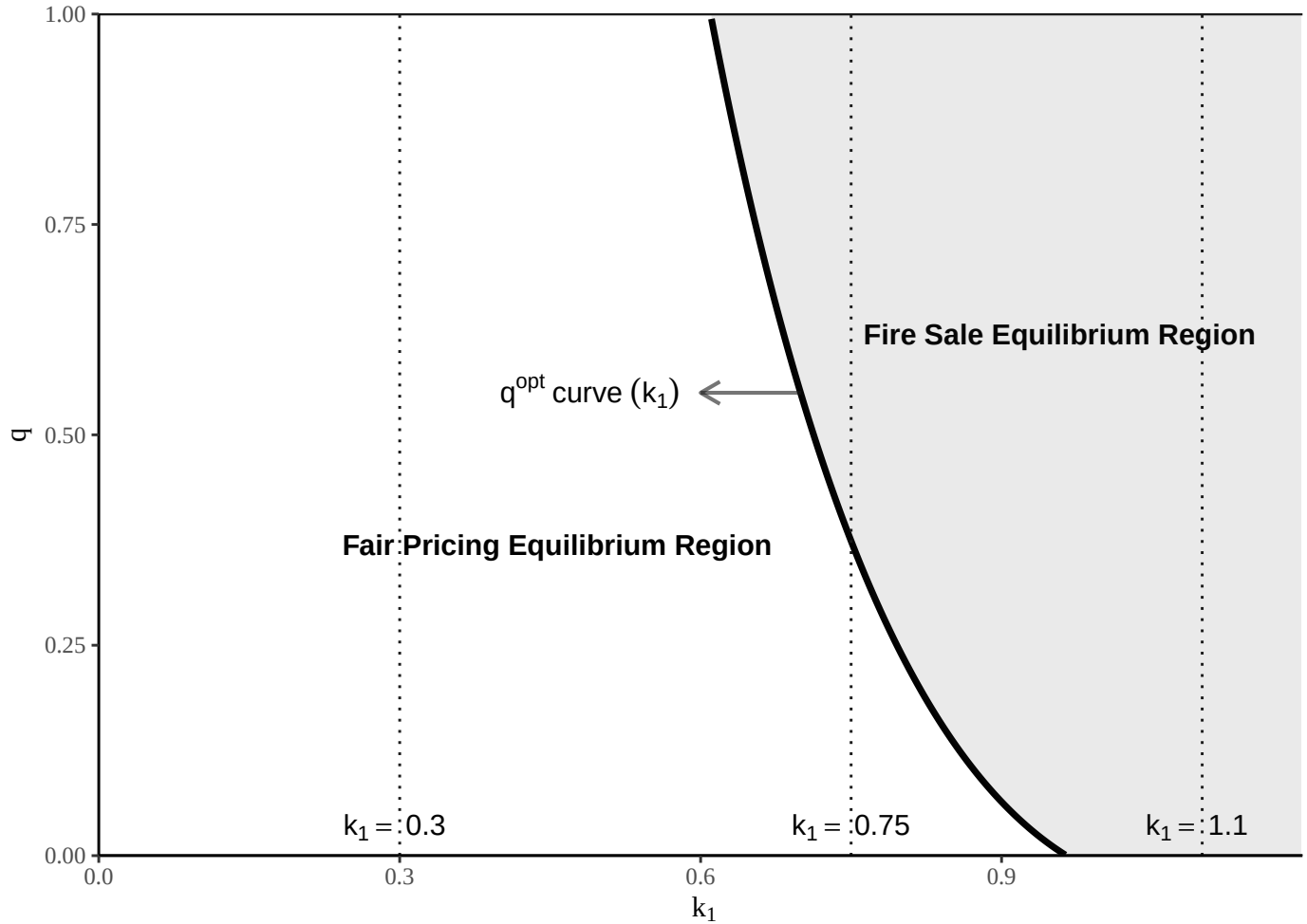
▸ Equilibrium Regions



Optimal bankruptcy exemption is ↓ in the shock size

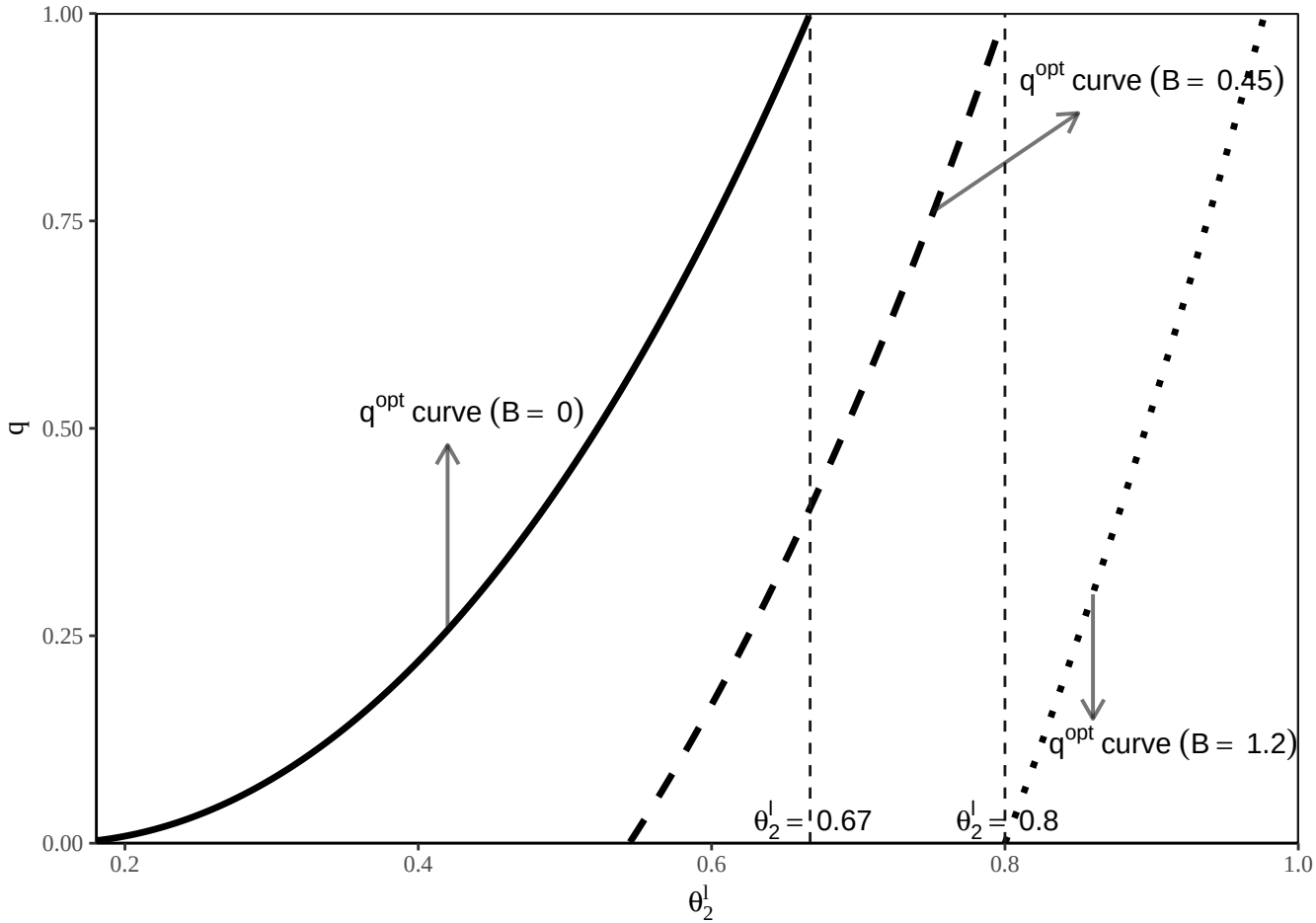


Optimal bankruptcy exemption is ↓ in the collateral quality



- For higher collateral quality (low k_1), there is more liquidity in the economy
  $\Longrightarrow$ the transition from FP to PD occurs at higher q
  $\Longrightarrow$ a higher optimal bankruptcy exemption level

Optimal bankruptcy exemption is ↓ in the real sector size



- For higher real sector size ($\mathscr{B}$), there is more liquidity required to be in the FP/PD region (fully satiated)
  - $\Longrightarrow$ the transition from FP to PD occurs at a lower q
  - $\Longrightarrow$ a lower optimal bankruptcy exemption level

◂ Optimal bankruptcy exemption

Conclusion

- The paper highlights the negative externality of bankruptcy exemption
- It shows that ex-ante leverage causes fire sales and liquidity diversion away from real investment during a crisis
- The main results are:
  - Full bankruptcy exemption is optimal only if policy makers are sure that there will be no fire sale effects
  - Whenever fire sale effects are likely, partial bankruptcy exemption or automatic stay is optimal
- Recent evidence suggests leveraged intermediaries such as hedge funds can lead to fire sales even in Treasury markets
  - Are safe harbors generating too much ex-ante liquidity for too little ex post?

THANK YOU

Related Literature

- Amplification of economic shocks through financial frictions
  - Inability to commit to loan repayments [Lorenzoni, 2008]
  - Moral hazard of borrower [Acharya and Viswanathan, 2011]

- Runs on the repo during the GFC [Gorton et al., 2020], [Gorton and Metrick, 2012], [Gorton et al., 2010], [Gorton and Metrick, 2010]

- Inefficiency of leverage induced fire sales [Stein, 2012]

- Runs in the repo market increase systemic risk [Krishnamurthy et al., 2014]

- Bankruptcy exemption of repo collateral increases systemic risk [Duffie and Skeel, 2012], [Acharya and Öncü, 2014]

- [Zhong and Zhou, 2021] endogenize ex-post bankruptcy payoffs in the ex-ante decision to stay invested in a firm

◂ Back

Relation with Acharya and Viswanathan (2011)

- The model differs from Acharya and Viswanathan (2011) in three significant ways

1. Strategic write-downs: Lenders and firms can negotiate a write-down and lender does not have full liquidation rights
2. New loan market: Liquidity surplus firms can provide new loans to real sector, apart from buying assets in secondary financial market
3. Moral hazard in real economy: Expected return on real assets depends on costly household effort which depends on interest rate

◂ Back

Constraints on Equilibrium Outcomes

- Firm's individual rationality constraint

$$\underbrace{ef_r - 1}_{\text{return on new loans}} \geq 0$$

- Household individual rationality constraint

$$\underbrace{R - f_r}_{\text{household payoff}} \geq 0$$

- Household incentive compatibility condition

$$e = \frac{1}{\gamma}(R - f_r), \quad 0 \leq e \leq 1$$

- Firm's incentive compatibility constraint

$$f_r \leq R/2$$

- Financial market rationality constraint

$$\rho^* \leq p \leq \theta_2 y_2$$

Back

Fair Pricing Equilibrium

- Minimum bankruptcy exemption q
- Enough liquidity to satiate total real sector demand, i.e.,
$$\overline{\beta} = \mathscr{B}$$
- Both real assets and financial assets are fairly priced. f_r is given by:
$$f_r = \frac{R}{2} - \frac{1}{2}\sqrt{R^2 - 4\gamma} < \frac{R}{2}$$
- Price is fixed at the fair value and is given by:
$$p = \theta_2 y_2$$

◂ Back

(Real Sector) Price Discrimination Equilibrium

- Small bankruptcy exemption q
- Enough liquidity to satiate total real sector demand, i.e.,

$$\overline{\beta} = \mathscr{B}$$

- Price (p) that clears the financial market is below its fair value (fire sale "price" effect)

$$p = \rho^* + \frac{1}{q}\int_{\rho_{min}}^{\rho^*} G(\rho)\,d\rho + \int_{\rho^*}^{p} G(\rho)\,d\rho - \frac{\mathscr{B}}{q}$$

- Real asset return tracks financial asset return and cross market arbitrage implies that lenders in real asset market extract surplus by discriminating on price (f_r) given by:

$$f_r = \frac{R}{2} - \frac{1}{2}\sqrt{R^2 - \frac{4\gamma k_1}{p-\rho^*}} < \frac{R}{2}$$

◂ Back

(Real Sector) Liquidity Crunch Equilibrium

- Medium bankruptcy exemption q
- Household moral hazard has peaked and f_r hits its maximum value of $\frac{R}{2}$, and consequently, real asset return hits the maximum value of $ef_r = \frac{R^2}{4\gamma}$
- Due to cross-market arbitrage, fixed f_r leads to fixed price p given by:

$$p = \rho^* + \underbrace{\frac{4\gamma k_1}{R^2}}_{\text{fixed premium}}$$

- Since price is fixed, only lever available to clear secondary market is withdrawing liquidity from real sector, i.e., $\overline{\beta} < \mathscr{B}$ (fire sale "quantity" effect)

$$\overline{\beta} = -q(p - \rho^*) + \int_{\rho_{min}}^{\rho^*} G(\rho)\, d\rho + q \int_{\rho^*}^{p} G(\rho)\, d\rho$$

◂ Back

(Real Sector) Credit Crunch Equilibrium

- High bankruptcy exemption q
- Liquidity is very low and real asset market is shut down ($\overline{\beta} = 0$)
- Financial market clearing price (p) adjusts to clear secondary market. More liquidations result in lower p (fire-sale "price" effect) given by

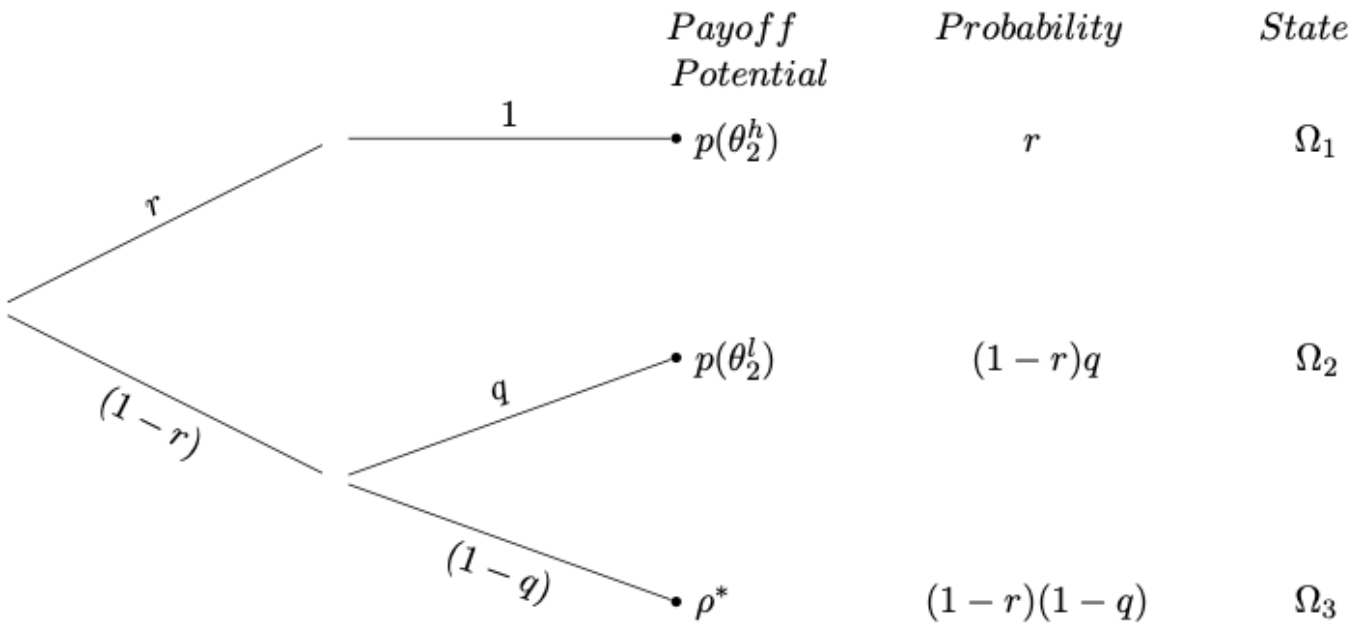
$$p = \rho^* + \underbrace{\frac{1}{q}\int_{\rho_{min}}^{\rho^*} G(\rho)\,d\rho + \int_{\rho^*}^{p} G(\rho)\,d\rho}_{\text{premium depends on } q}$$

- Cross-market arbitrage does not apply (because all surplus liquidity is deployed to buy liquidated assets, i.e., $\overline{\beta} = 0$)
- Financial assets dominate real assets (i.e., $\frac{k_1}{p-\rho^*} > ef_r$, at equilibrium)

◂ Back

Payoff Potential

- Lenders recover the asset price ($p\left(\theta_2^h\right)$ or $p\left(\theta_2^l\right)$) upon liquidation and ρ^* upon write-down
- Payoff potential of firms under different states:



- Note: In the bad state (θ_2^l), lender's expected payoff is

$$\overline{p}\left(\theta_2^l, q\right) = \underbrace{qp\left(\theta_2^l, q\right)}_{\text{liquidation}} + \underbrace{(1-q)\rho^*}_{\text{write-down}}$$

Back

Shortfall Financing

- For a given face-value (ρ), amount of shortfall financed ($s(\rho)$) is equal to the expected payoff potential across states

ρ	Default States	Non-default States	Investment Shortfall That is Financed by Debt ($s(\rho)$)
$\rho_{min} \leq \rho \leq \rho^*$	$\varnothing$	$\Omega_1, \Omega_2, \Omega_3$	ρ
$\rho^* < \rho \leq p(\theta_2^l)$	Ω_3	Ω_1, Ω_2	$[r + (1-r)q]\rho + (1-r)(1-q)\rho^*$
$p(\theta_2^l) < \rho \leq p(\theta_2^h)$	Ω_2, Ω_3	Ω_1	$r\rho + (1-r)\bar{p}(\theta_2^l)$
$p(\theta_2^h) < \rho$	$\Omega_1, \Omega_2, \Omega_3$	$\varnothing$	$rp(\theta_2^h) + (1-r)\bar{p}(\theta_2^l)$

◂ Back

Endogenous Distribution of Debt at Date 0

- Maximum amount of investment shortfall that can be financed is given by

$$\hat{s} = \underbrace{rp\left(\theta_2^h\right) + (1-r)\,\overline{p}\left(\theta_2^l\right)}_{\text{expected recovery by lender}}$$

- Given a uniform distribution of investment shortfall ($U[s_{min}, s_{max}]$), distribution of ρ is given as

$$\hat{G}(\rho) = \frac{s(\rho) - s_{min}}{\hat{s} - s_{min}}$$

- In other words, firms with investment shortfall ($\tilde{s}$) lower than $\hat{s}$ are financed

◂ Back

Effect of Bankruptcy Exemption, q

Proposition 3

In price discrimination equilibrium,

$$\frac{dp}{dq} < 0 \quad \frac{d\overline{p}}{dq} < 0 \quad \frac{df_r}{dq} > 0 \quad \frac{d\overline{\beta}}{dq} = 0$$

- Price change acts as a lever to clear secondary market and leads to fire sale "price" effect
- Price decreases with q because fire sale "price" effect increases with q
- Lender's payoff ($\overline{p} = qp + (1-q)\rho^*$) decreases in q as fire-sale "price" effect ($\frac{dp}{dq}$) dominates pure liquidation effect
- Cross-market arbitrage implies that real market return tracks financial market return and f_r increases with q
- Real asset origination is at the maximum ($\overline{\beta} = \mathscr{B}$) and invariant to q

◂ Back

Effect of Bankruptcy Exemption, q

Proposition 3 (contd.)

In liquidity crunch equilibrium,

$$\frac{dp}{dq} = 0 \quad \frac{d\overline{p}}{dq} > 0 \quad \frac{df_r}{dq} = 0 \quad \frac{d\overline{\beta}}{dq} < 0$$

- Face value (f_r) hits peak value of $\frac{R}{2}$ and is invariant to q
- Due to cross-market arbitrage, financial market returns are also fixed and price p is invariant to q
- Lender's payoff ($\overline{p}$) increases in q due to "pure liquidation" effect
- Real asset origination ($\overline{\beta}$) *decreases* in q because higher liquidation of financial assets sucks more liquidity away from real assets (fire sale "quantity" effect)

◂ Back

Effect of Bankruptcy Exemption, q

Proposition 3 (contd.)

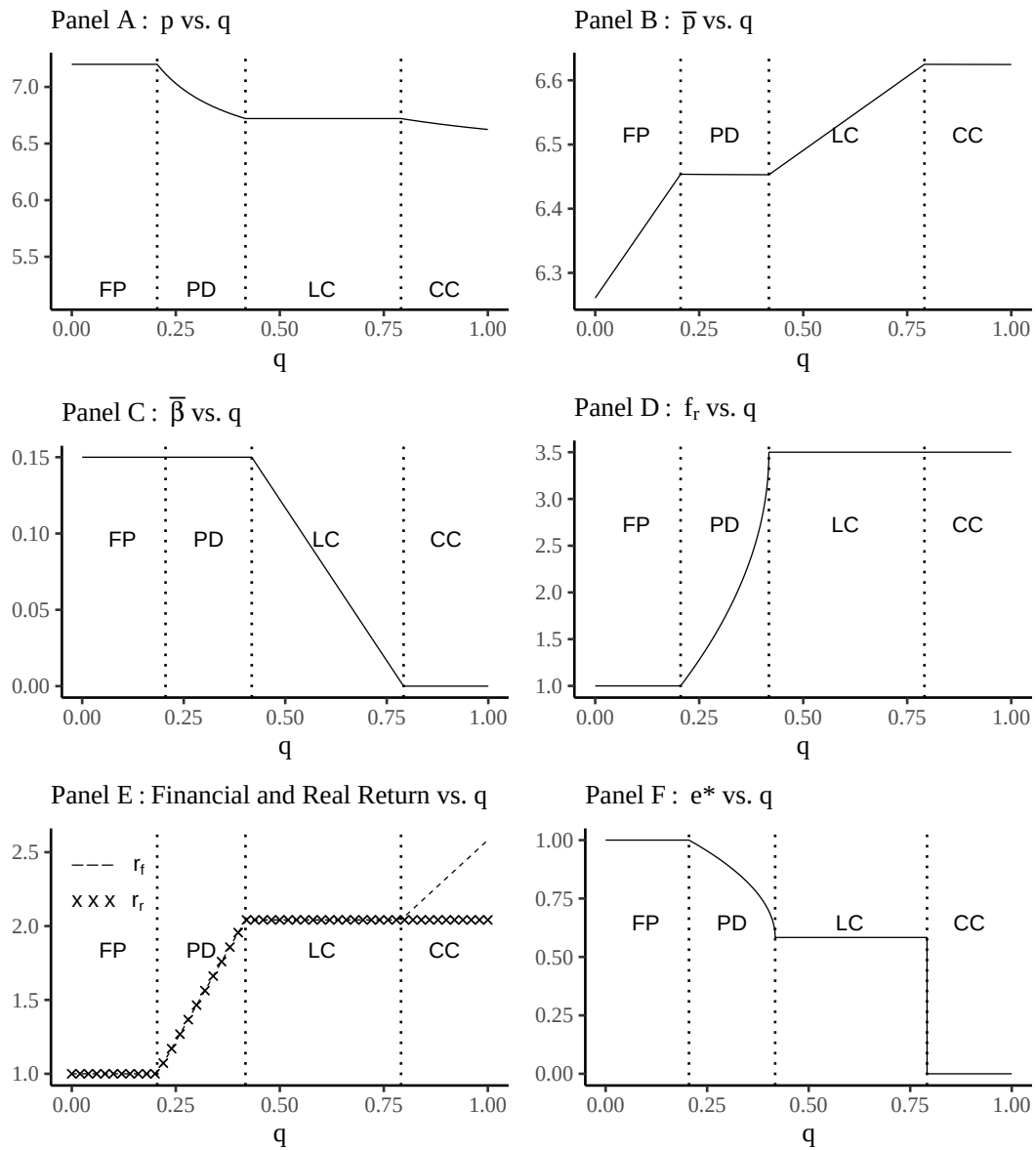
In credit crunch equilibrium,

$$\frac{dp}{dq} < 0 \qquad \frac{d\overline{p}}{dq} < 0$$

- When q is high, more liquidations arise and resulting fire sales lead to lower price (p)
- Lender's payoff ($\overline{p}$) increases due to lower write-downs (pure "liquidation" effect) but decreases due to lower price ("price" effect)
- Overall, the fire sale price effect dominates and $\overline{p}$ *decreases* in q

◂ Back

Equilibrium Characteristics



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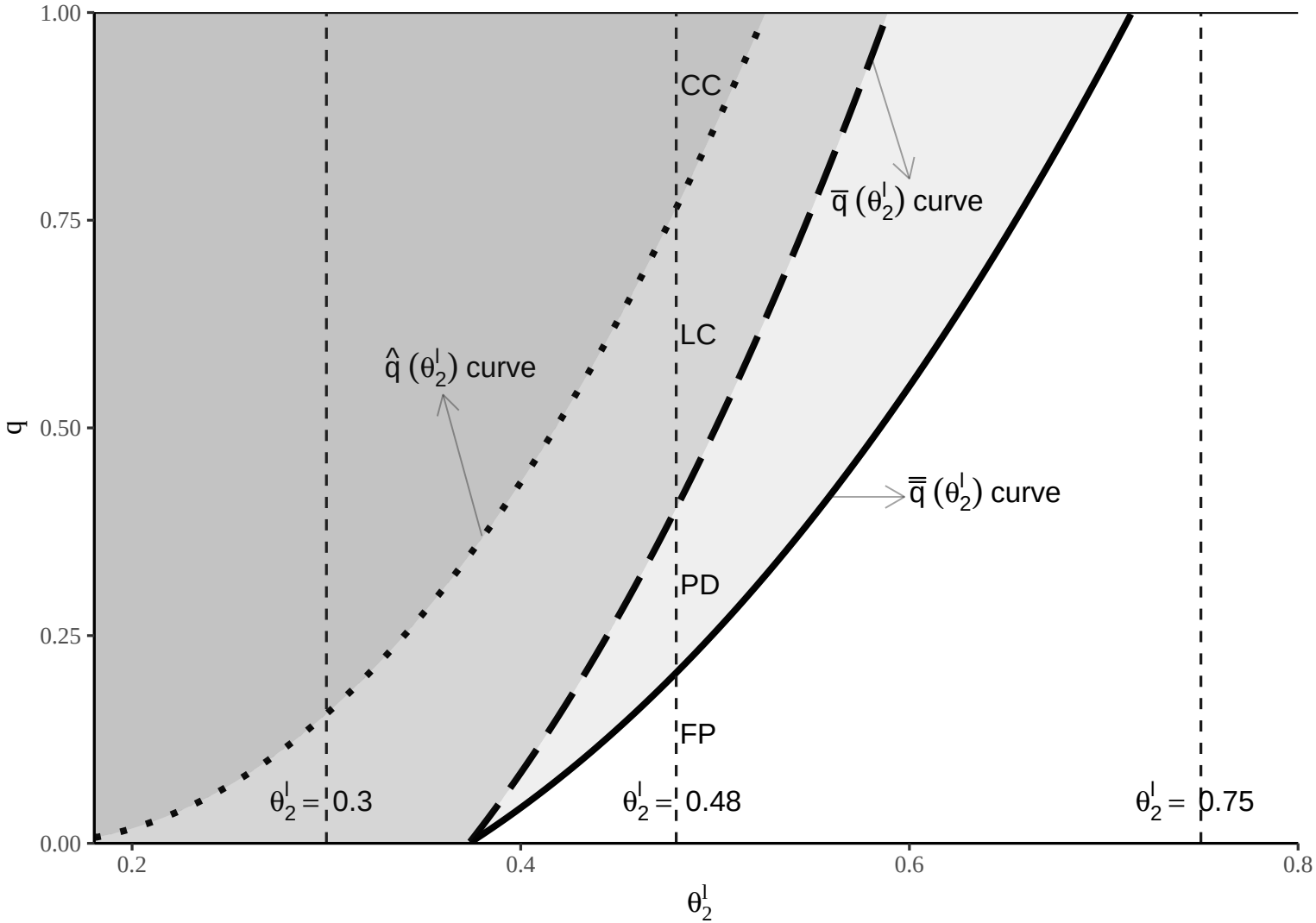
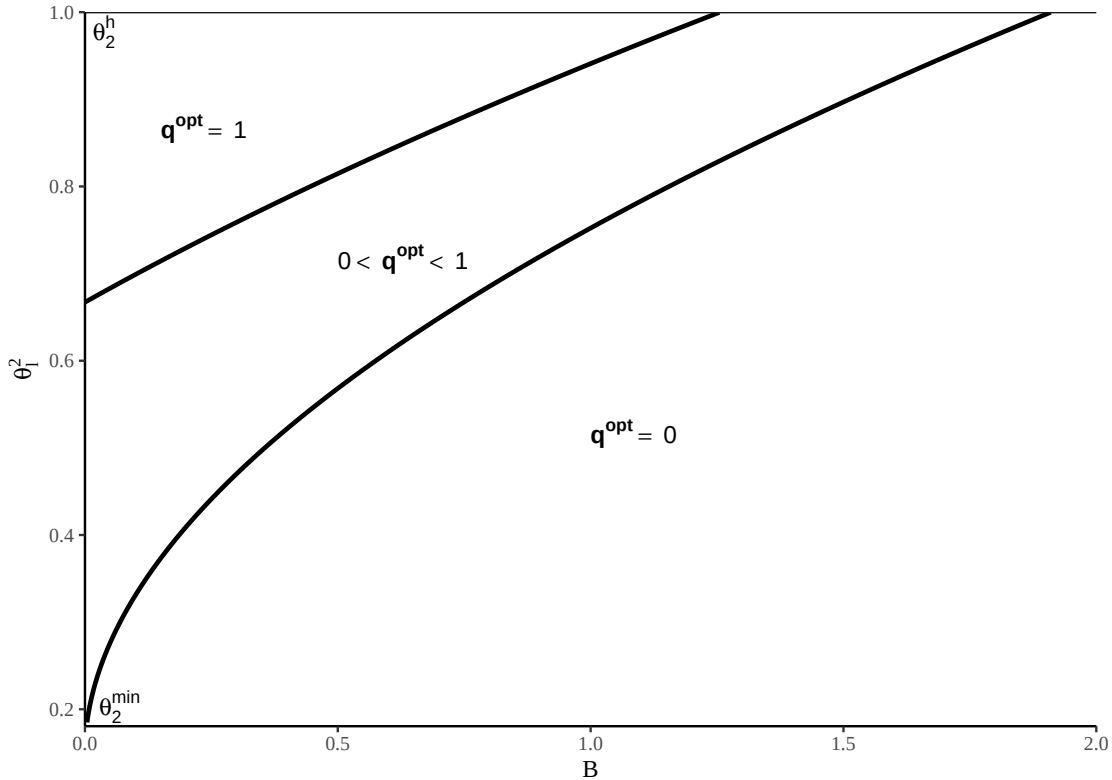
Equilibrium Regions (Detailed)



▸ Proposition 3 ▸ Proposition 4

When is Bankruptcy exemption more likely to be optimal?



- For economies with a small real sector size (small $\mathscr{B}$) and nature of expected adverse shock is mild (high θ_2^l), bankruptcy exemption ($q = 1$) is optimal
- When the real sector size is large (large $\mathscr{B}$) or a severe adverse shock is expected (low θ_2^l), bankruptcy exemption ($q = 1$) is not optimal

◂ Back

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