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

Viral V. Acharya V. Ravi Anshuman S. Viswanathan

NYU Stern IIM Bangalore Duke Fuqua

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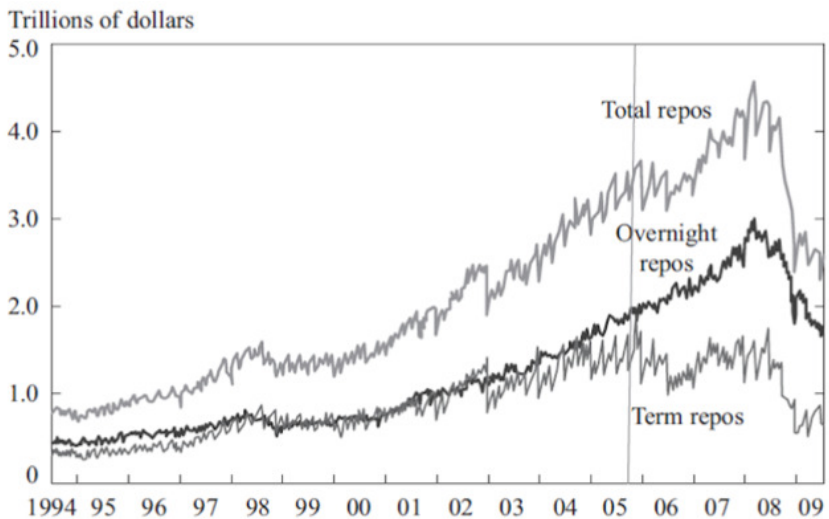
Repurchase Agreement

- 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]

Role of Safe Harbor Provision

- 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 (Garbade [2006], Acharya and Viswanathan [2011], Infante [2013], and Lewis [2023]) 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

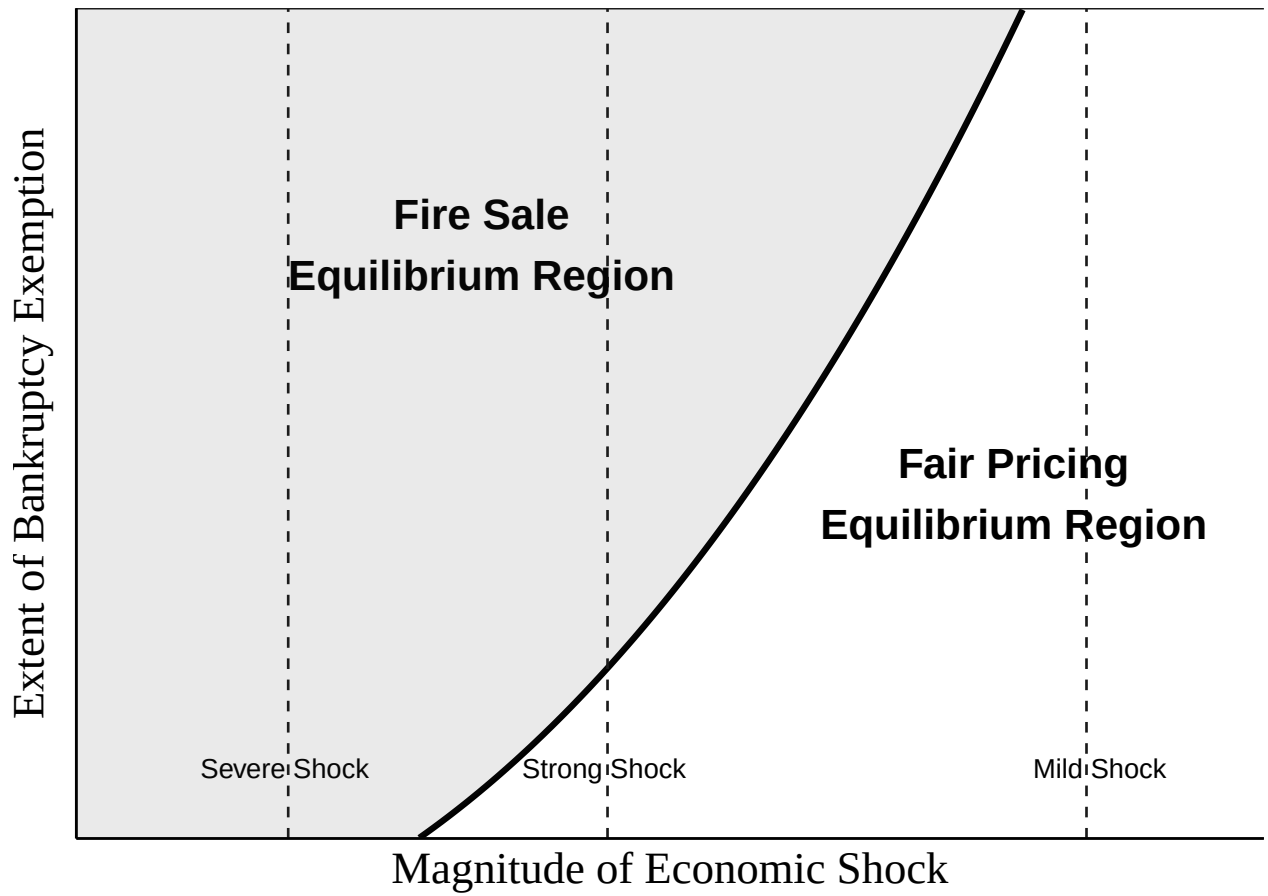
- In partial equilibrium, granting liquidation rights to lenders enables financial firms to increase leverage and originate more assets

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

- Fire-sale effect (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



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 / Externalities of leverage induced fire sales [Stein, 2012], [Dávila and Korinek, 2018], [Lanteri and Rampini, 2023]

- 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

Model Setup

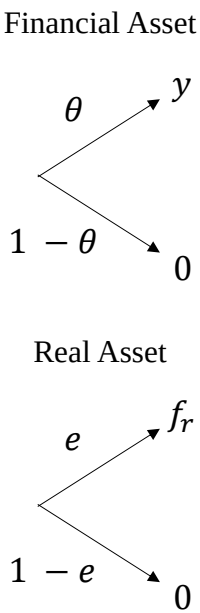
- Two-period, three-date world (Date 0, 1, and 2)

- **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)

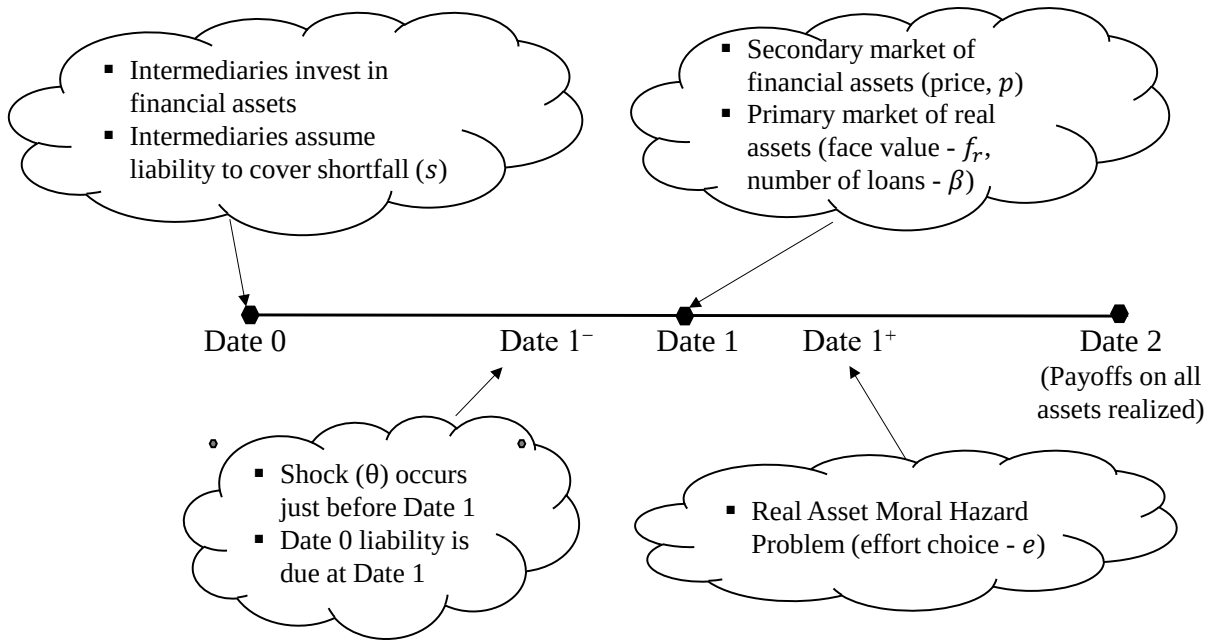
- **Assets**: There are two assets in the economy
  1. Financial assets (e.g., legacy loans): Can be pledged at Date 0 to raise repo financing
  2. Real assets (e.g., new mortgages or small-business loans): Cannot be pledged to raise capital due to asset specificity

Asset Payoffs and Sequence of Events

Panel A: Asset Payoffs



Panel B: Sequence of Events



▸ Relation with AV(2011)

Outline of the Solution

1. The ex-post model (Date 1)
   - Optimization behavior of agents
   - Cross-market equilibrium characteristics (p, f_r, β)
2. The ex-ante model (Date 0)
   - Shortfall financing and endogenizing debt distribution at Date 0
   - Total Surplus equals surplus creation at Date 0 and Date 1
3. Role of bankruptcy exemption on total surplus

Lender's Decision to Roll Over Debt at Date 1

- Firm's incentive compatibility and investors individual rationality limits the debt capacity of safer asset [Acharya and Viswanathan, 2011]

- Debt capacity (or funding liquidity) of the safer asset is

$$\rho^* = \underbrace{\theta y - k}_{\text{pledgeable return}} \qquad \textit{where}, \quad k > 0$$

- k is the non-pledgeable portion of expected cash flows due to risk-shifting agency problem

- Note: ρ^* is *increasing* in θ, i.e., adverse economic shock (i.e., lower θ) lowers the capacity to roll over debt

Household Moral Hazard Problem at Date 1

- Households borrow at Date 1 and commit to repay f_r at Date 2
- They invest in a real asset that
  - Requires costly effort (e) with cost given by $\frac{1}{2}\gamma e^2$
  - Returns R with probability e and zero otherwise
- Household's first order condition gives optimal effort as

$$e^* = \frac{1}{\gamma}(R - f_r)$$

- Household effort (e^*) is *decreasing* in interest rate (f_r)

Liquidation Decision of Constrained Firms

- Constrained firms ($\rho > \rho^*$) can sell financial assets to surplus firms ($\rho < \rho^*$) at price p, which is endogenously obtained
- Note:
  - Mildly constrained firms ($\rho^* \leq \rho \leq \bar{\rho}$) will partially liquidate where $\bar{\rho} = \rho^* + q(p - \rho^*)$ is the expected proceeds to the lender in the event of a default
  - Severely constrained firms ($\rho > \bar{\rho}$) will default

- If $g(\rho)$ denotes the pdf of ρ, aggregate assets for sale supplied by constrained firms (i.e., with $\rho \geq \rho^*$) is given by

$$S(p, \rho^*) = \int_{\rho^*}^{\bar{\rho}} \frac{\rho - \rho^*}{p - \rho^*} \, g(\rho) \, d\rho + \int_{\bar{\rho}}^{\rho_{\max}} q \, g(\rho) \, d\rho. \tag{1}$$

Investment Decision of Surplus-liquidity Firms

- Unconstrained firms (i.e., with $\rho < \rho^*$) will use surplus liquidity to
  - buy α units of financial assets (at price p)
  - lend β units as new loans to the real sector

- **Firm's problem**:

$$\max_{\alpha>0,\beta\geq 0} \underbrace{(1+\alpha)(\theta y - \rho^*)}_{\text{financial sector payoff}} + \underbrace{\beta ef_r}_{\text{real sector payoff}}$$

subject to budget constraint on liquidity

$$\underbrace{\alpha(p-\rho^*)+\beta}_{\text{investment in financial and real assets}} \leq \underbrace{\rho^* - \rho}_{\text{available liquidity}}$$

Optimal Action of Surplus-liquidity Firms

- Equilibrium Returns in Financial and Real Asset Markets
  - Financial asset return is marginal benefit over marginal cost, i.e., $\frac{k}{p-\rho^*}$
  - Return on new loans is ef_r

- **Case 1**: When both financial asset and real asset markets are open
  - Return on both assets is positive and real investment is positive

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

- **Case 2**: When only the financial asset market is open
  - Financial asset dominates real asset and real investment is zero

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

Financial Market Clearing Price

- Price (p) is obtained from equating aggregate investment in financial market ($\overline{\alpha}$) and real market ($\overline{\beta}$) with surplus liquidity ($S(p, \rho^*)$)

$$\underbrace{\overline{\alpha}(p-\rho^*)+\overline{\beta}}_{\text{investment in financial and real assets}} = \underbrace{\int_{\rho_{min}}^{\rho^*}(\rho^*-\rho)\,g(\rho)\,d\rho}_{\text{surplus liquidity available}}$$

- Market clearing price can be solved as

$$p = \rho^* + \underbrace{\frac{1}{qG(\rho_{max})}\left[\int_{\rho_{min}}^{\bar{\rho}} G(\rho)d\rho - \bar{\beta}\right]}_{\text{Spare Liquidity in the Economy}} \tag{2}$$

▸ Equilbrium Constraints

Equilibrium Regions

- For a given shock (θ), there are four equilibrium regions depending on bankruptcy exemption parameter (q)
  1. Fair Pricing Region
  2. Fire Sale Region
     - ⋆ Price Discrimination Region
     - ⋆ Liquidity Crunch Region
     - ⋆ Credit Crunch Region
- 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

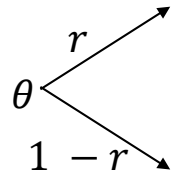
Equilibrium Regions

Bankruptcy Exemption (q)	Equilibrium		Financial Asset Pricing (p)	Real Asset Supply ($\overline{\beta}$)	Real Asset 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

- Basic structure: θ can be θ^h with probability r (good state) and θ^l with probability $1-r$ (bad state)



$$\theta^h \qquad p(\theta^h) = \theta^h y^h \quad ; e^*(\theta^h) f_r(\theta^h) = 1 \quad ; \quad k(\theta^h) = 0$$

$$\theta^l \qquad p(\theta^l) \leq \theta^l y^l \quad ; e^*(\theta^l) f_r(\theta^l) \geq 1 \quad ; \quad k(\theta^l) > 0, ; \; k'(\theta^l) \leq 0$$

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

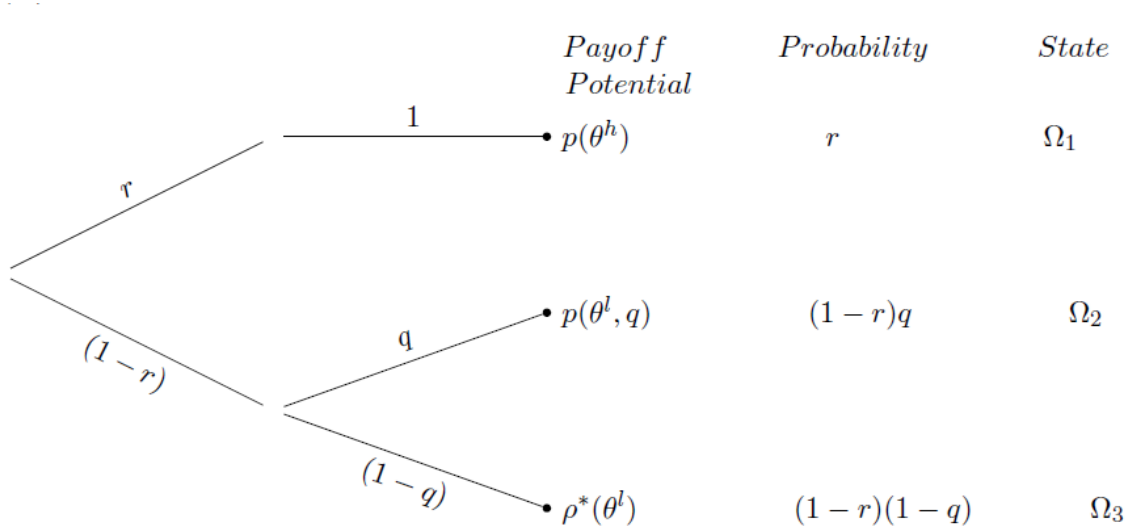
Good State versus Bad State

- In the good state ($\theta = \theta^h$, Asset Payoff $= y^h$, $\gamma = 0$)
  - No moral hazard problems
  - All firms will be able to roll over their debt
  - Assets are priced at fair value, and there is no unmet demand in the real sector ($\overline{\beta} = \mathscr{B}$)
- In the bad state ($\theta = \theta^l < \theta^h$, Asset Payoff $= y^l < y^h$, $\gamma > 0$)
  - Moral hazard problems exist
  - Some firms may be unable to roll over their debt resulting in fire-sales with assets being priced at a discount to fair value

Payoff Potential

- Lenders recover the asset price ($p\left(\theta^h\right)$ or $p\left(\theta^l\right)$) upon liquidation and ρ^* upon write-down

- Payoff potential of firms under different states:



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

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

Shortfall Financing

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

- For a given face-value (ρ), amount of shortfall financed ($s(\rho)$) is equal to the expected payoff potential across states
- Maximum amount of investment shortfall that can be financed ($\hat{s}$):

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

Endogenous Distribution of Debt at Date 0

- 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 shortfalls ($\tilde{s}$) lower than $\hat{s}$ are financed

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	$+$	0	▸ Details-PD
Liquidity Crunch	0	$+$	0	$-$	▸ Details-LC
Credit Crunch	$-$	0	NA	NA	▸ Details-CC

Surplus Creation

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

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

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

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

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

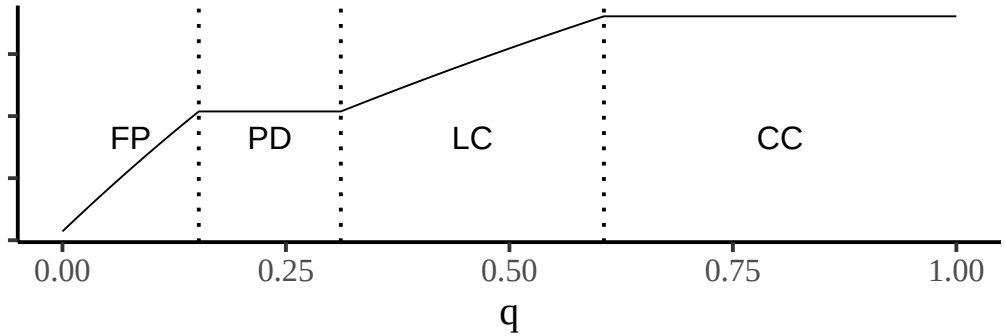
$$S_{D0}\left(q;\theta^I\right) = \int_{s_{min}}^{\hat{s}} \underbrace{E_\theta\left[\theta y - s\right]}_{\text{expected NPV}} dH(s)$$

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

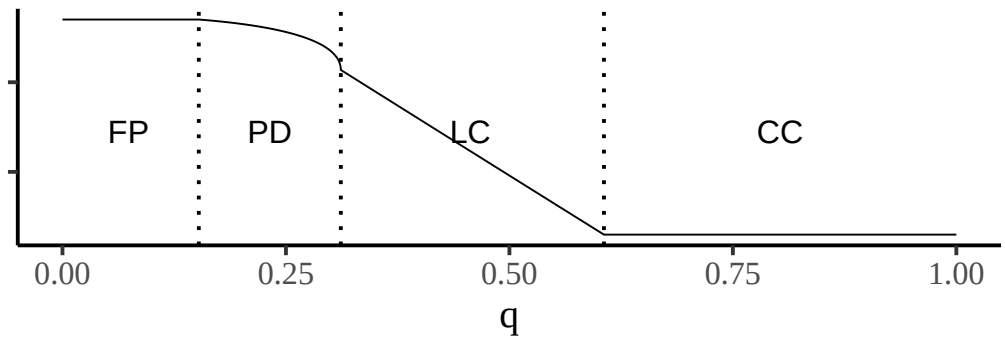
$$S_{Total}(q;\theta^I) = S_{D1}(q;\theta^I) + S_{D0}(q;\theta^I)$$

Surplus Creation due to Bankruptcy Exemption

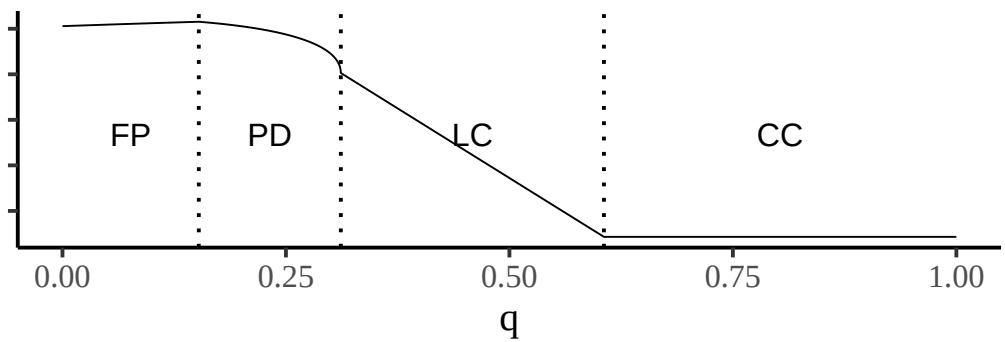
Panel A : S_{D0} vs. q



Panel B : S_{D1} vs. q

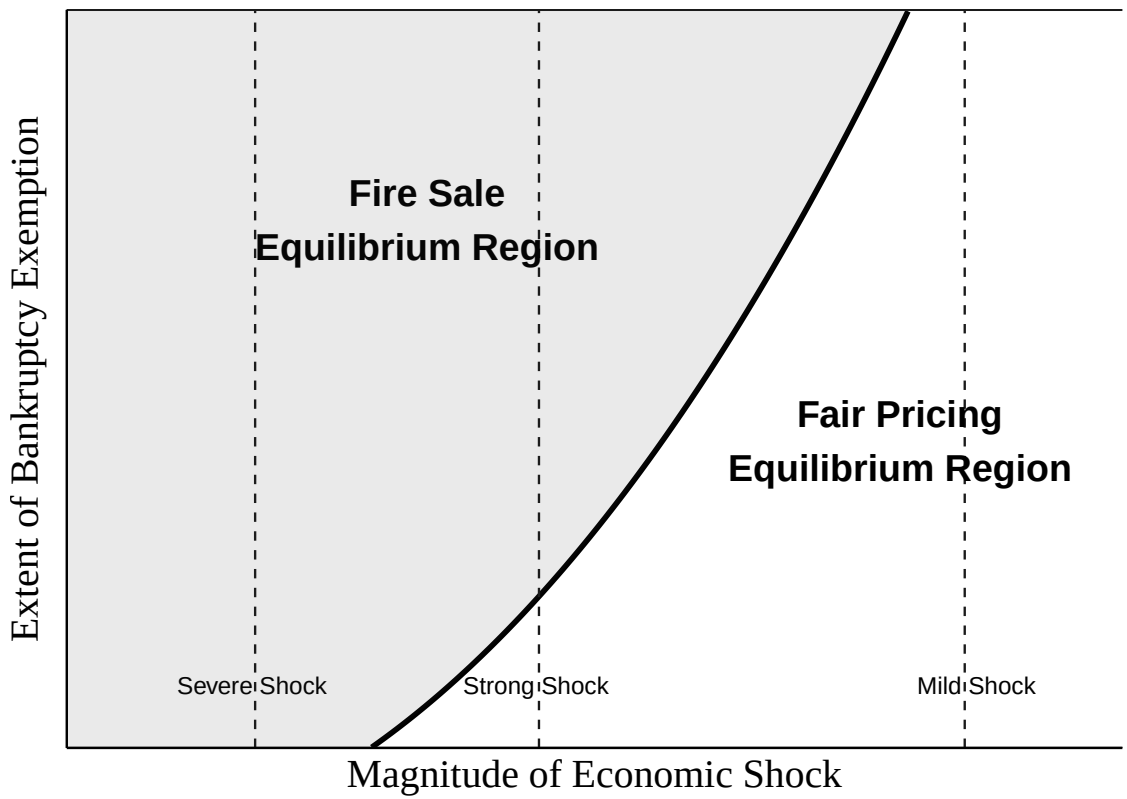


Panel C : S_{Total} vs. q



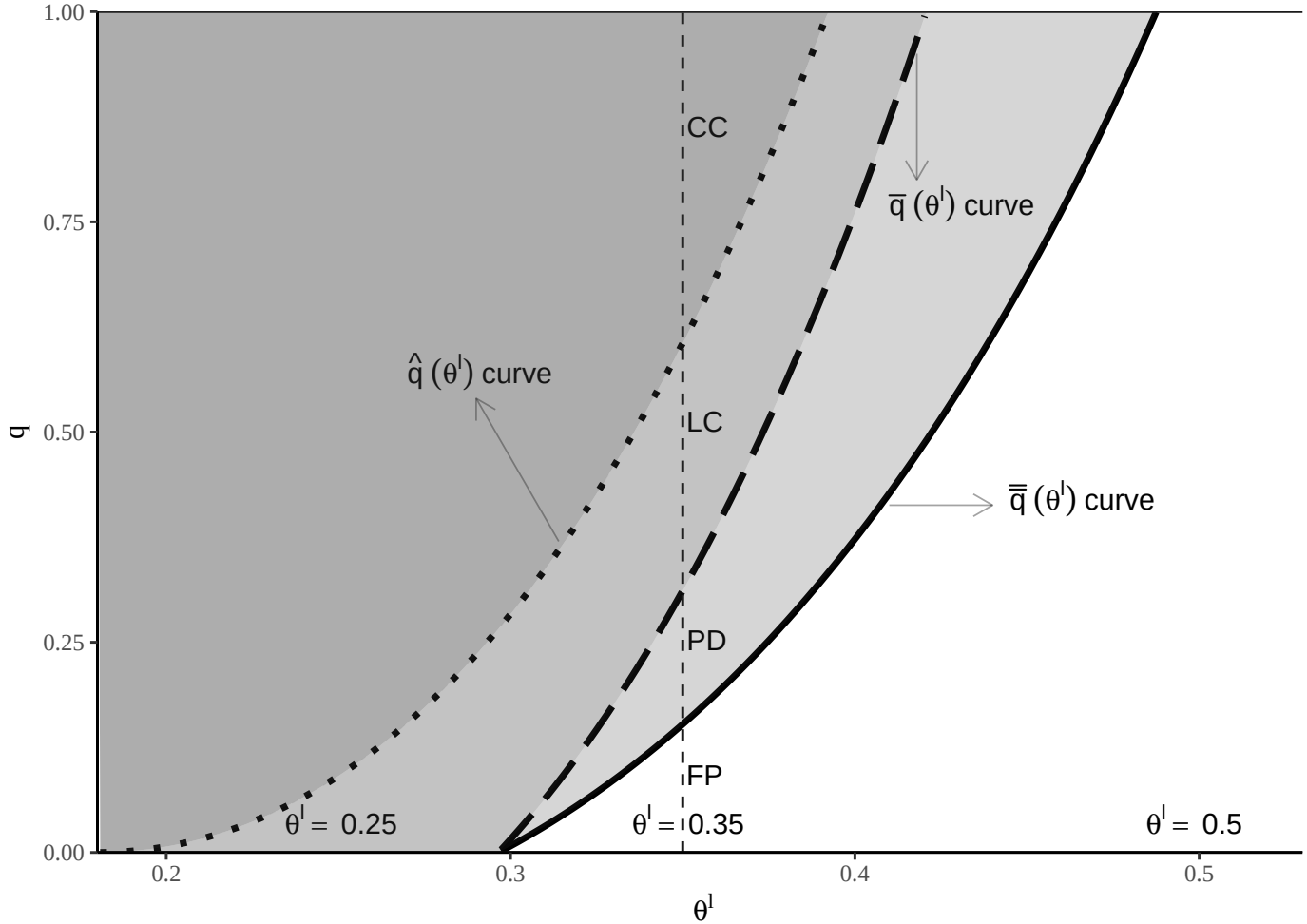
Proposition 3

For payoff structures of financial assets underlying repo and real asset loans underlying Date 1 loans that satisfy $E_\theta[\rho^*(\theta)] \geq \theta^l y^l$, the optimal q (q^{opt}) that maximizes total surplus (S_{Total}) is at the border of the Fair Pricing region and the Fire Sale region.



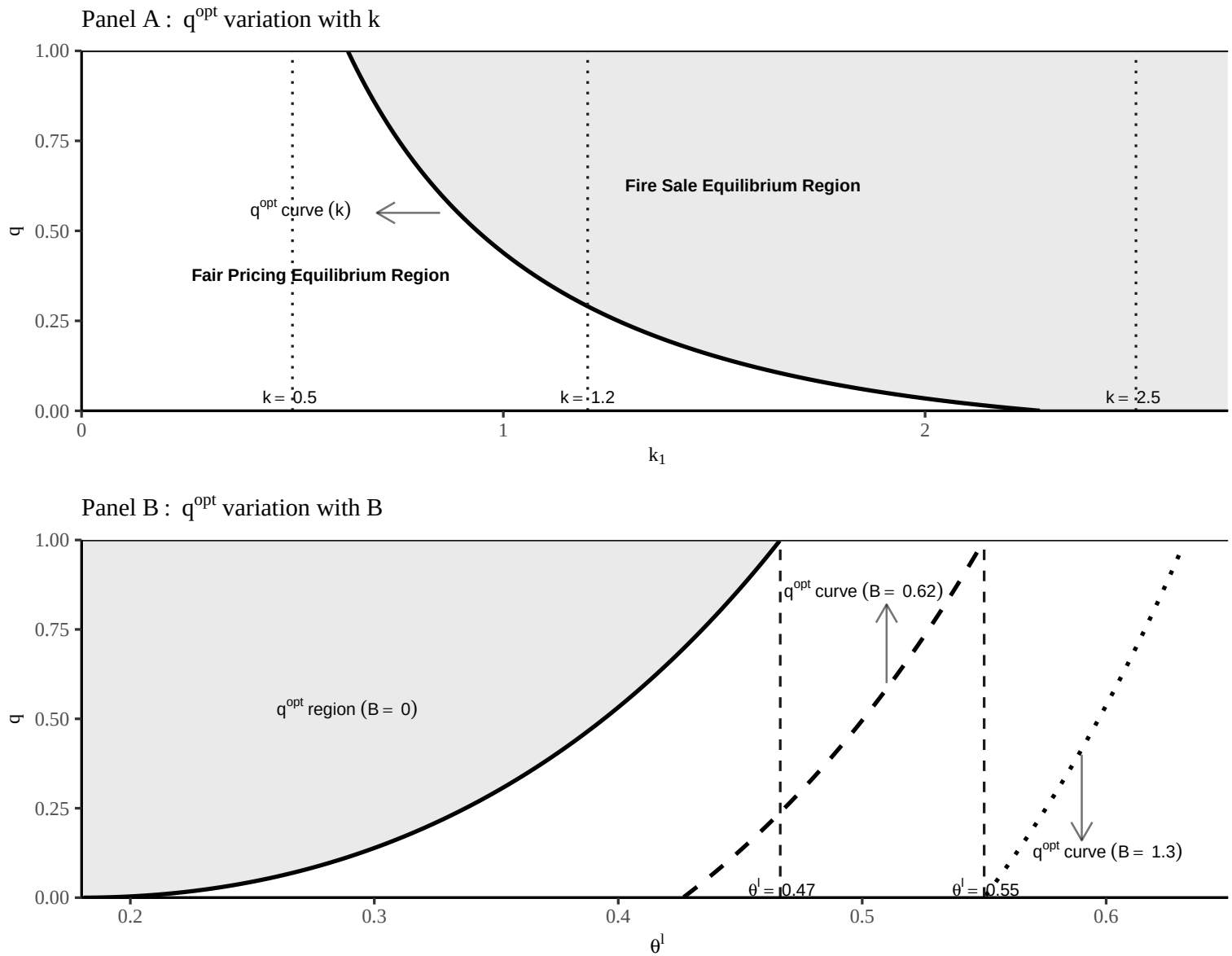
▸ Equilibrium Characteristics

Optimal bankruptcy exemption is ↓ in the shock size



- The transition from FP to PD captures the optimal bankruptcy exemption level
- For a milder shock (high θ^l), 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

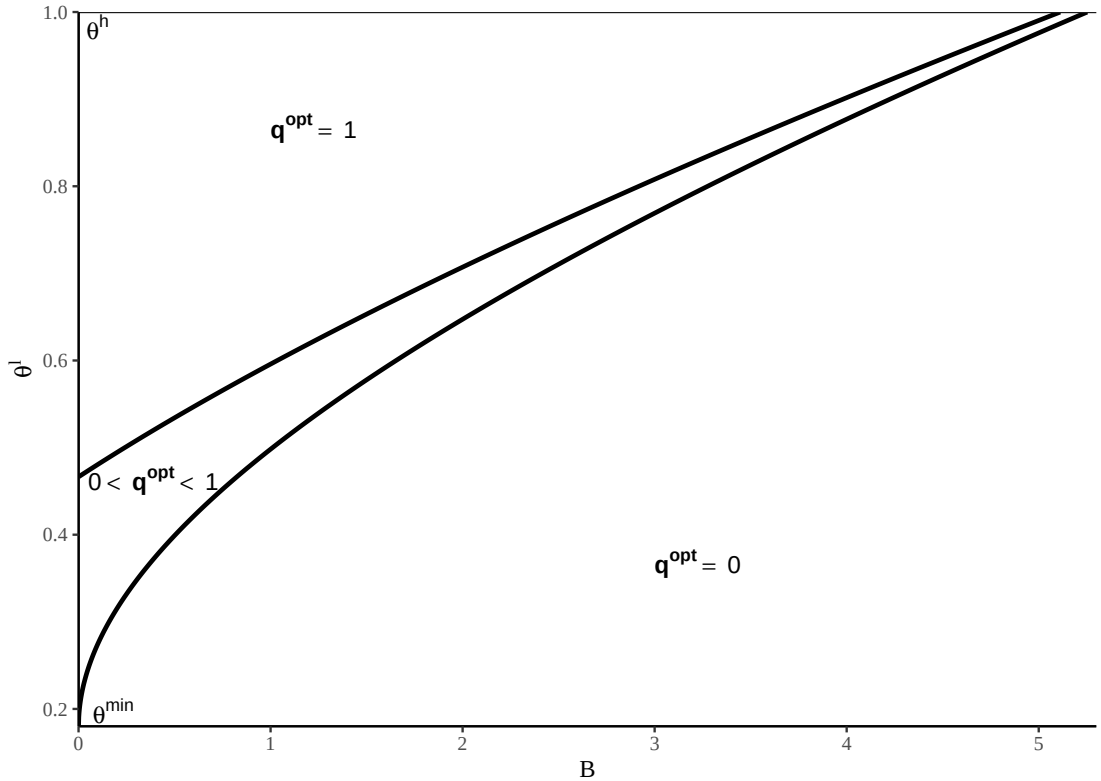
Optimal bankruptcy exemption is ↓ in collateral quality and ↓ in the real sector size



Proposition 5

A social planner aiming to maximize total surplus by imposing external capital constraints can never improve upon the total surplus achieved by setting the bankruptcy exemption parameter at the border of the Fair Pricing region and the Price Discrimination region.

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^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^l), bankruptcy exemption ($q = 1$) is not optimal

Conclusion

- The paper highlights the negative externality of bankruptcy exemption
- It shows that higher ex-ante leverage (induced by bankruptcy exemption) 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

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

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:
$$p = \theta y$$

◂ 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)

$$p = \rho^* + \frac{1}{q\ G(\rho_{max})}\left[\int_{\rho_{min}}^{\bar{\rho}} G(\rho)d\rho - \mathscr{B}\right]$$

- 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:

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

◂ 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:

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

- 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)

$$\bar{\beta} = -q(p - \rho^*)\ G(\rho_{max}) + \int_{\rho_{min}}^{\bar{\rho}} G(\rho) d\rho < \mathscr{B}$$

◂ 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

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

- 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., $\frac{k}{p-\rho^*} > ef_r$, at equilibrium)

◂ 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 ($\overline{p} = qp + (1-q)\rho^*$) is invariant to q as fire-sale "price" effect ($\frac{dp}{dq}$) is offset by the pure liquidation effect
- Cross-market arbitraging activity 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.)

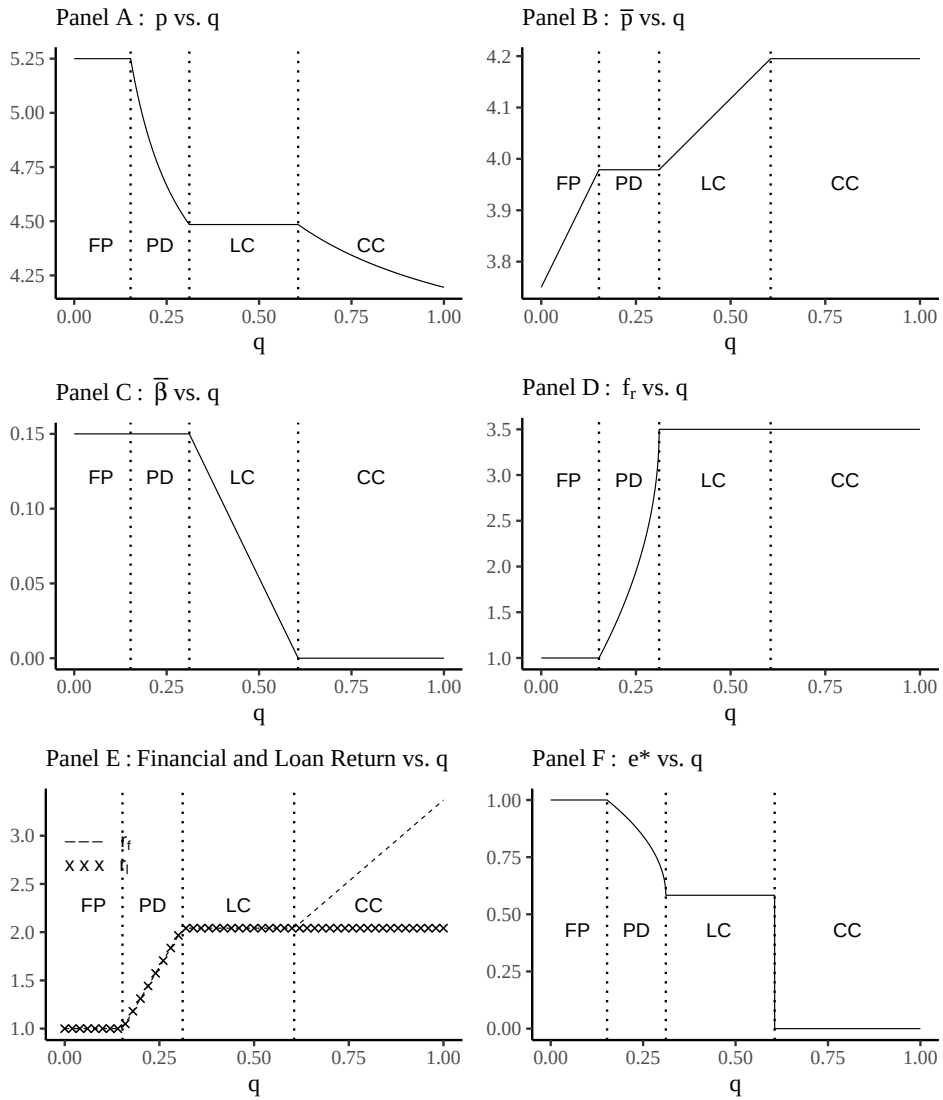
In credit crunch equilibrium,

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

- When q is high, more liquidations arise and resulting fire sales lead to lower price (p)
- Overall, the fire sale price effect is offset by the liquidation effect and $\overline{p}$ is *invariant* to q

◂ Back

Equilibrium Characteristics



◂ Back

Equilibrium Characteristics of Each Region

Fair Pricing region	Price Discrimination region	Liquidity Crunch region	Credit Crunch region
$\bar{\beta} \leftrightarrow$ with q $f_r \leftrightarrow$ with q $\Rightarrow S_{D1} \leftrightarrow$ with q	$\bar{\beta} \leftrightarrow$ with q $f_r \uparrow$ with q $\Rightarrow S_{D1} \downarrow$ with q	$\bar{\beta} \downarrow$ with q $f_r \leftrightarrow$ with q $\Rightarrow S_{D1} \downarrow$ with q	$\bar{\beta} \leftrightarrow$ with q $f_r \leftrightarrow$ with q $\Rightarrow S_{D1} \leftrightarrow$ with q
$\bar{p} \uparrow$ with q $\hat{s} \uparrow$ with q $\Rightarrow S_{D0} \uparrow$ with q	$\bar{p} \leftrightarrow$ with q $\hat{s} \leftrightarrow$ with q $\Rightarrow S_{D0} \leftrightarrow$ with q	$\bar{p} \uparrow$ with q $\hat{s} \uparrow$ with q $\Rightarrow S_{D0} \uparrow$ with q	$\bar{p} \leftrightarrow$ with q $\hat{s} \leftrightarrow$ with q $\Rightarrow S_{D0} \leftrightarrow$ with q
$S_{Total} \uparrow$ with q	$S_{Total} \downarrow$ with q	$S_{Total} \downarrow\uparrow$ with q	$S_{Total} \leftrightarrow$ with q

▸ 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

$$\rho^* \leq p \leq \theta y$$

▸ Equilibrium Price

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