Cournot Fire Sales

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The views expressed in the paper are those of the authors and are not necessarily reflective of views at the Federal Reserve Bank of New York or the Federal Reserve System.

Introduction

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- Does this increase in pricing power in *secondary asset* markets make the financial system more or less stable?
- In the next crisis, will the consequences of fire sales be more or less severe?

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- Many U.S. industries have become extremely concentrated in recent decades and investment is low (compared to Q)
- How does this increase in pricing power in *secondary* markets (e.g., capital, M&A) affect investment?
- Are firms under-investing (or just holding cash) for "precautionary/predatory" reasons?

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- Walrasian equilibria in standard models with incomplete markets exhibit:
  1. Too little liquidity on the asset side
  2. Too much leverage on the liability side
- Why? Price-taking agents do not internalize how their portfolios depress prices after adverse shocks

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  $\Longrightarrow$ depends on the model

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What we do

- We consider two standard macro-finance models:
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- We consider two standard macro-finance models:
  1. a model of liquidity shocks with illiquid assets
  2. a model of productivity shocks with borrowing constraints
- ...with modifications to risk and pricing power:
  1. the economies feature both aggregate and idiosyncratic risk
  2. agents internalize how their portfolio choices will affect asset prices à la Cournot competition

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- Because there is idiosyncratic risk, buyers and sellers have (potentially) differential price impacts
- Because there is aggregate risk, the price impacts can (potentially) diverge systematically and significantly
- Because there is Cournot competition, agents strategically consider their price impacts

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Two main results:

1. Cournot equilibrium may *exacerbate* overinvestment in illiquid assets

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- And we think these results are the empirically relevant cases if pricing power in asset markets is high

Outline

1. **Liquidity Model**
2. Production Model

Liquidity Model

Overview: à la Diamond and Dybvig (1983)

- Three periods, $t = 0, 1, 2$
- At $t = 0$ investors have two investment options
  1. *Liquid* assets: 1 unit at $t = 0$ delivers 1 in $t = 1$ or $t = 2$
  2. *Illiquid* assets: 1 unit at $t = 0$ delivers $R > 1$ at $t = 2$ but 0 at $t = 1$
- At $t = 1$ illiquid assets can be traded at endogenous price p

Liquidity Model

Investors

- Investors start with one unit to invest at $t = 0$
- Have preferences à la Diamond and Dybvig (1983):
  - will consume in either $t = 1$ or $t = 2$ (uninsurable)
  - early consumers are hit by *liquidity shocks* forcing them to liquidate holdings of illiquid assets
  - late consumption discounted by $\beta \leq 1$ with $\beta R > 1$
- (RRA > 1 and $\beta < 1$ imply demand for liquidity)

Liquidity Model

Structure of Uncertainty

Aggregate state	Probability	Liquidity shock	Consumption	Asset price
Good state	α	Nobody hit	$\overline{c}$	$\overline{p} = R$
Mixed state	$1 - \alpha$	Hit (Pr $= \frac{1}{2}$) Not hit (Pr $= \frac{1}{2}$)	c_L c_H	$p < R$

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$$\implies p = \frac{\ell}{1-\ell}.$$

- (p determined by "cash in the market")

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Competitive Equilibrium

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- Social Planner takes into account that more liquidity
  1. increases the price by $\frac{dp}{d\ell}$
  2. which benefits sellers, who gain $\frac{dp}{d\ell}u'(c_L)$
  3. and hurts buyers, who lose $\frac{dp}{d\ell}\frac{1}{p}\beta R u'(c_H)$

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- Compared to Walrasian equilibrium, Social Planner considers additional FOC term

$$\frac{dp}{d\ell}\left(u'(c_L) - \frac{1}{p}\beta R u'(c_H)\right) > 0$$

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- More liquidity/higher price provides liquidity insurance (fire sales depress p)

Liquidity Model

Cournot Equilibrium

- A Cournot investor takes into account that more liquidity
  1. increases the price received by $\frac{dp_L}{d\ell_i}$ *when she's a seller*, and she gains $\frac{dp_L}{d\ell_i} u'(c_L)$
  2. increases the price paid by $\frac{dp_H}{d\ell_i}$ *when she's a buyer*, and she loses $\frac{dp_H}{d\ell_i} \frac{1}{p} \beta R u'(c_H)$

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$$\frac{dp_L}{d\ell_i}u'(c_L) - \frac{dp_H}{d\ell_i}\frac{1}{p}\beta R u'(c_H)$$

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$$\frac{dp_L}{d\ell_i} u'(c_L) - \frac{dp_H}{d\ell_i} \frac{1}{p} \beta R u'(c_H)$$

- This generally differs from SP term and need not be positive!

Liquidity Model

Conditions for under/overprovision of liquidity

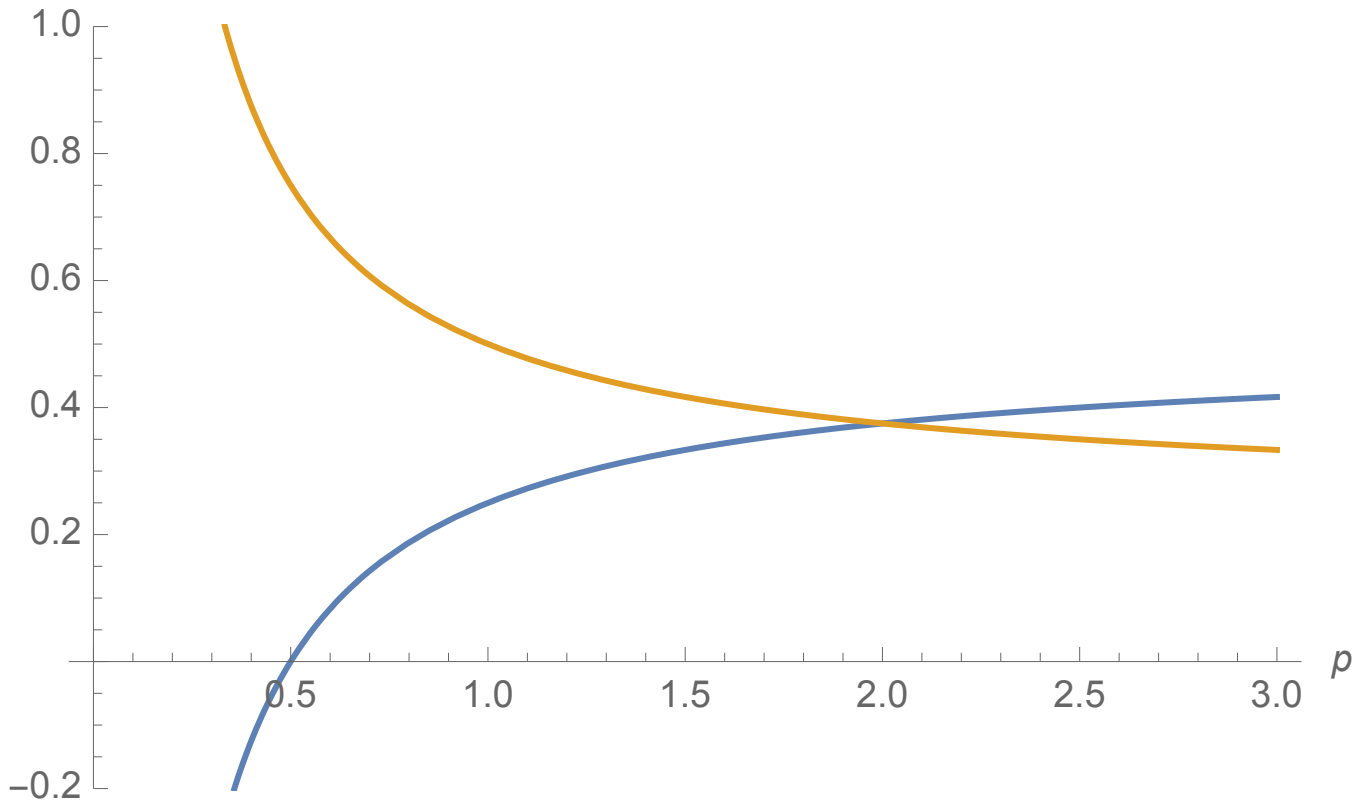


Figure: Yellow: Social Planner term, Blue: Cournot term, $N = 1$, $\beta = 0.5$ and $R = 5$, Log utility.

Liquidity Model

Cournot Equilibrium with Aggregate Risk

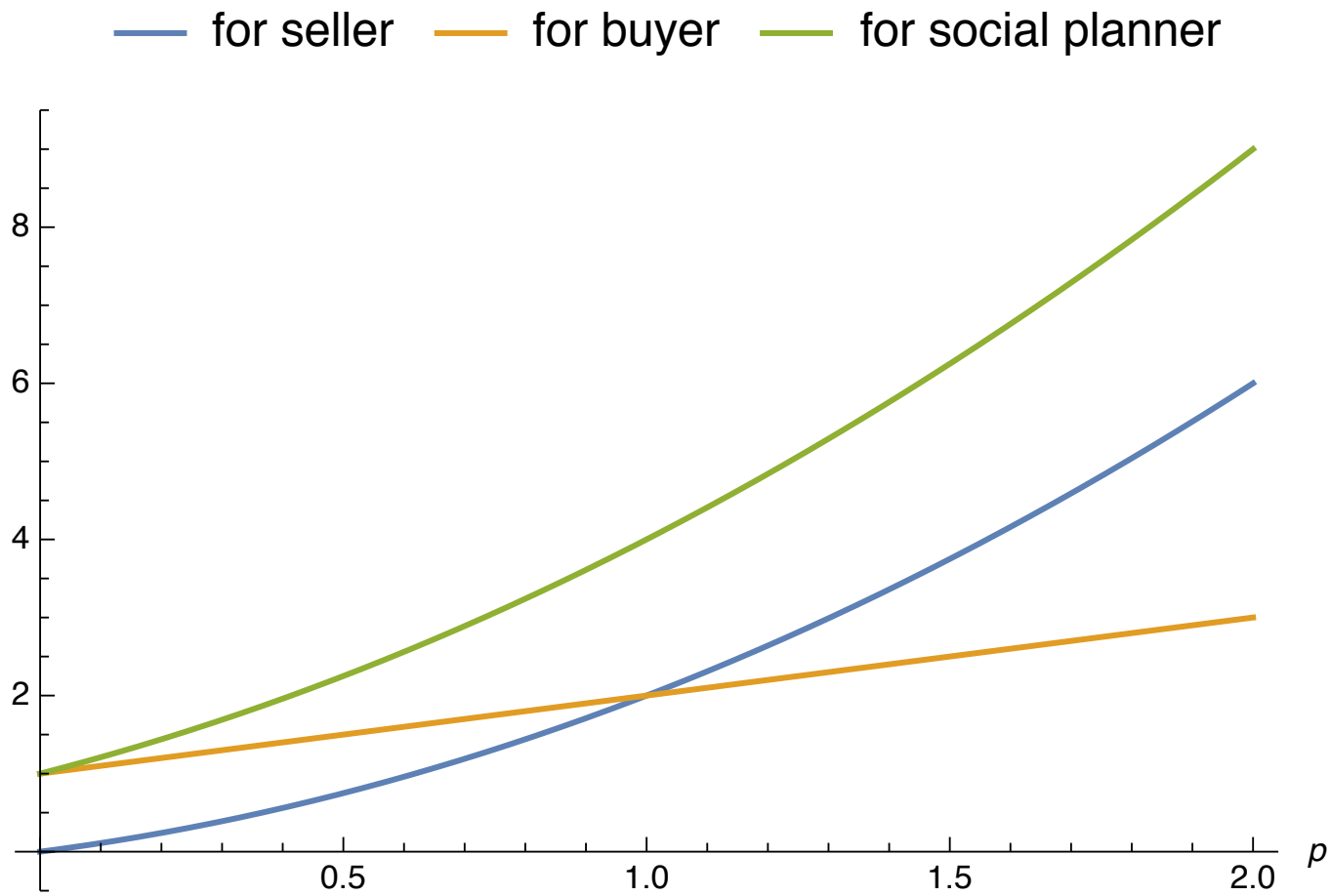


Figure: Effects of liquidity on Cournot price for $N = 1$

Liquidity Model

Cournot Equilibrium with Aggregate Risk

- What does this mean for Cournot liquidity provision?

Liquidity Model

Liquidity with aggregate and idiosyncratic risk

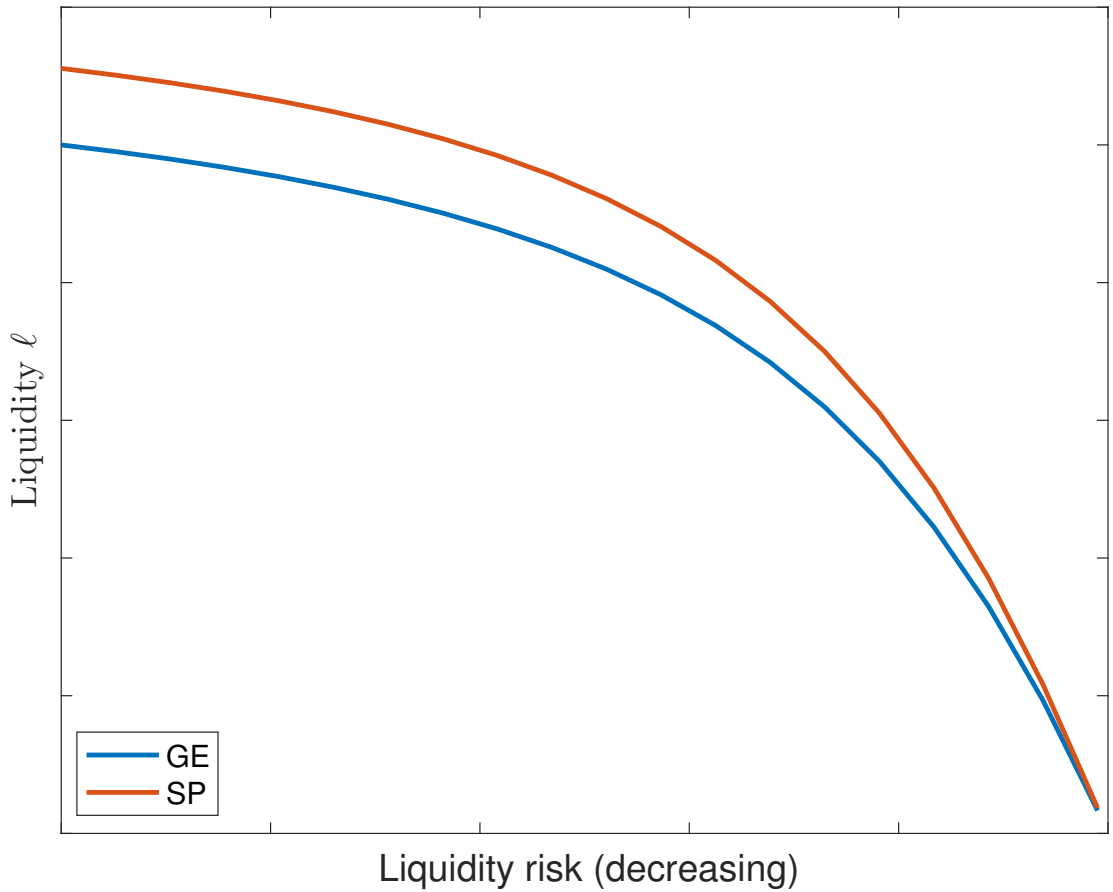
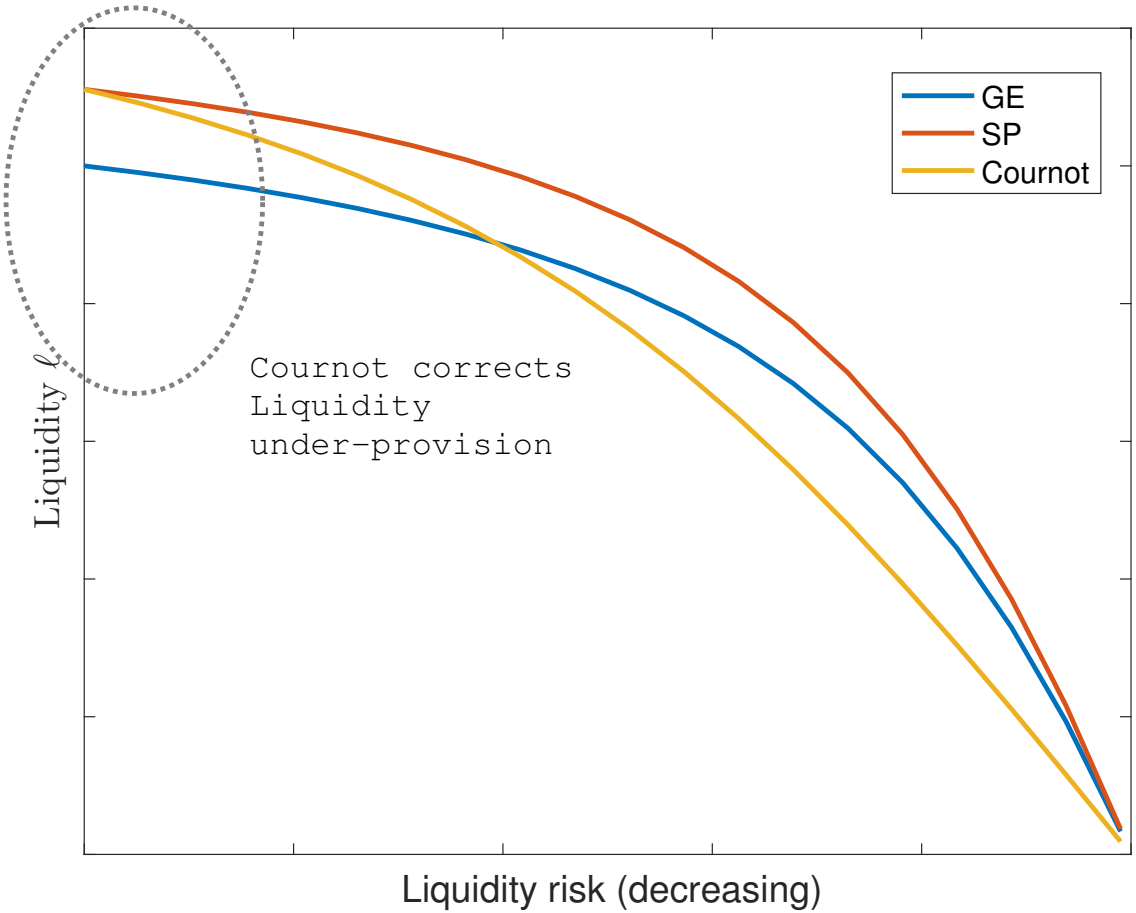


Figure: Aggregate Liquidity Risk and Liquidity Provision with Cournot

Liquidity Model

Liquidity with aggregate and idiosyncratic risk



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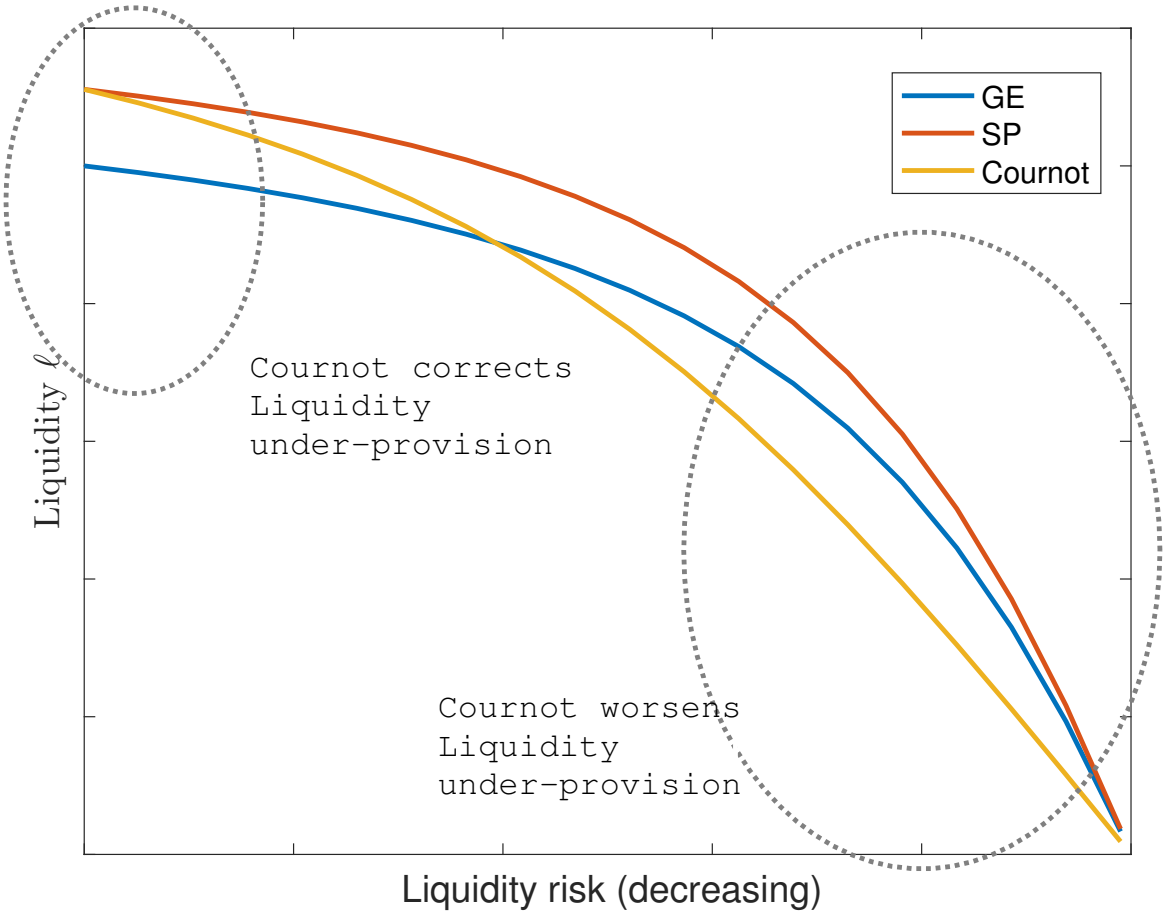

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Liquidity Model

Summary of Results

- With no aggregate risk, Cournot *mitigates* externality:
  - liquidity near or at efficient level
- With low liquidity risk, Cournot *exacerbates* externality:
  - liquidity below competitive level

Outline

1. Liquidity Model
2. **Production Model**

Production Model

Overview

- Three periods, $t = 0, 1, 2$
- Two agents, households and firms
- Firms are efficient users of capital, have small endowment n, and borrow to buy additional capital
- Due to borrowing constraints, firms may have to sell capital at $t = 1$ to repay debts

Production Model

Technology

- Firm production:
  - capital k chosen at $t = 0$ produces Ak units of goods at $t = 1$, with A stochastic (expected value 1)
  - production at $t = 1$ produces goods one-for-one (no risk)

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  - downward sloping demand for capital at $t = 1$ (produce $a \log(1 + k)$ units of goods at $t = 2$, $a \leq 1$)

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- At $t = 0$, capital price is $q_0 < 1$ (capital produced from goods at linear rate)

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Preferences

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- Firms have utility $u(c)$ over final consumption, do not discount, and can borrow d to buy capital at $t = 0$

$$q_0 k = n + d$$

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- No borrowing at $t = 1$, so if cash flow from production insufficient to repay debts firms forced to sell capital

Production Model

Aggregate state	Probability	Productivity shock	Consumption	Capital price
Good state	α	$\overline{A}$	$\overline{c}$	$\overline{q} = 1$
Mixed state	$1 - \alpha$	A_L A_H	c_L c_H	$q < 1$

- Average productivity in the mixed state is low

$$\underline{A} = \frac{1}{2}\left(A_H + A_L\right) < q_0$$

- Baseline: $A_H > q_0$ (idiosyncratic risk is high)

Production Model

Equilibrium with aggregate and idiosyncratic risk

In mixed/bad state:

- Firms with bad shocks sell capital to repay debts

Production Model

Equilibrium with aggregate and idiosyncratic risk

In mixed/bad state:

- Firms with bad shocks sell capital to repay debts
- But firms with good shocks *buy* capital with spare output

Production Model

Equilibrium with aggregate and idiosyncratic risk

In mixed/bad state:

- Firms with bad shocks sell capital to repay debts
- But firms with good shocks *buy* capital with spare output
- Given restriction on $\underline{A}$, capital price is

$$q = a - (q_0 - \underline{A})\, k + n$$

- Fire-sale price is decreasing in aggregate k
- (Get same price function with or without idiosyncratic risk)

Leverage Model

Efficient investment with aggregate and idiosyncratic risk

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  - Less capital misallocated to low-productivity households

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Cournot investment with only aggregate risk

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- All firms want higher q to minimize fire sales
- Cournot mitigates externality (as in standard Cournot, firms internalize only partial price impact)
- Same result so long as $A_L \approx A_H$

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  - Pushes up price
  - which is bad!
- Cournot agents think more marginal capital is always bad

Leverage Model

Cournot investment with aggregate and idiosyncratic risk

- Internalizing price effect, Cournot agents want marginally less capital *no matter their eventual type*

Leverage Model

Cournot investment with aggregate and idiosyncratic risk

- Internalizing price effect, Cournot agents want marginally less capital *no matter their eventual type*
  $\Longrightarrow$ Cournot investment *below* efficient level

Production Model

Investment with aggregate and idiosyncratic risk

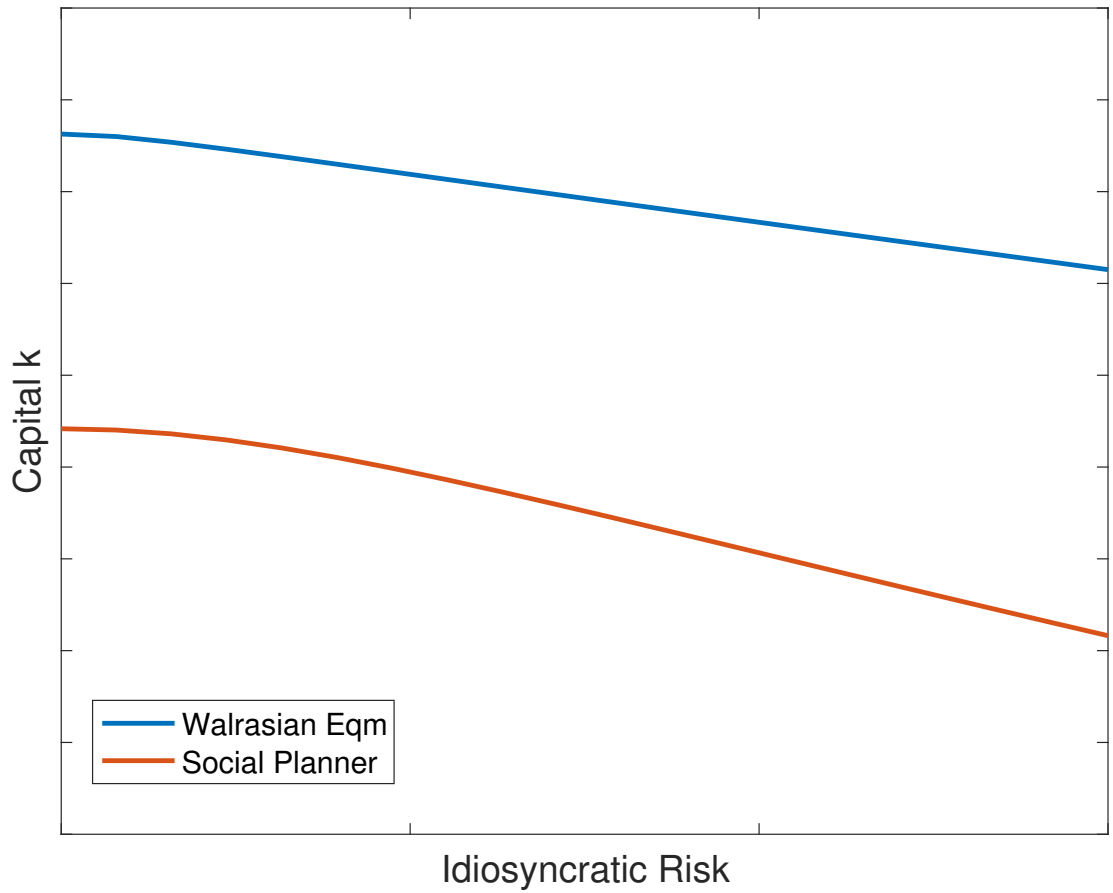
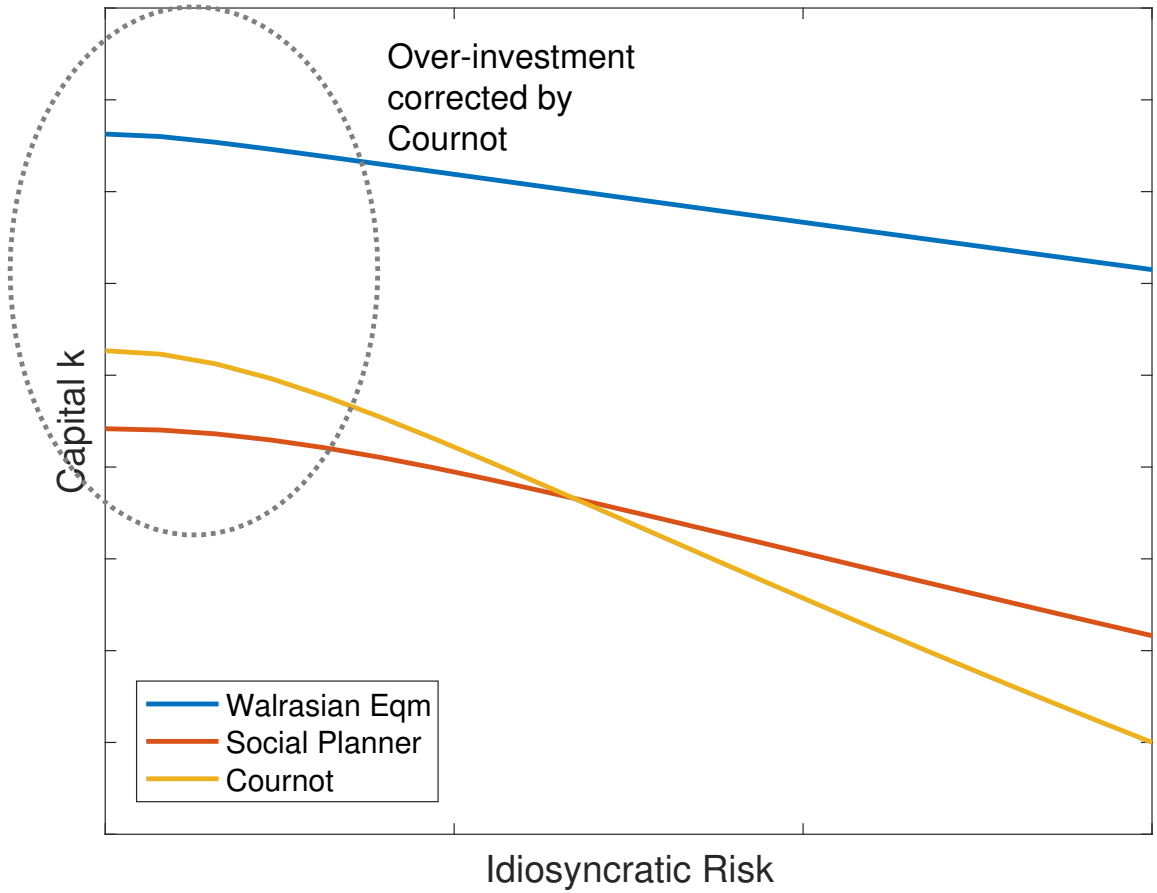


Figure: Idiosyncratic Risk and Over/Underinvestment with Cournot

Production Model

Investment with aggregate and idiosyncratic risk



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Production Model

Investment with aggregate and idiosyncratic risk

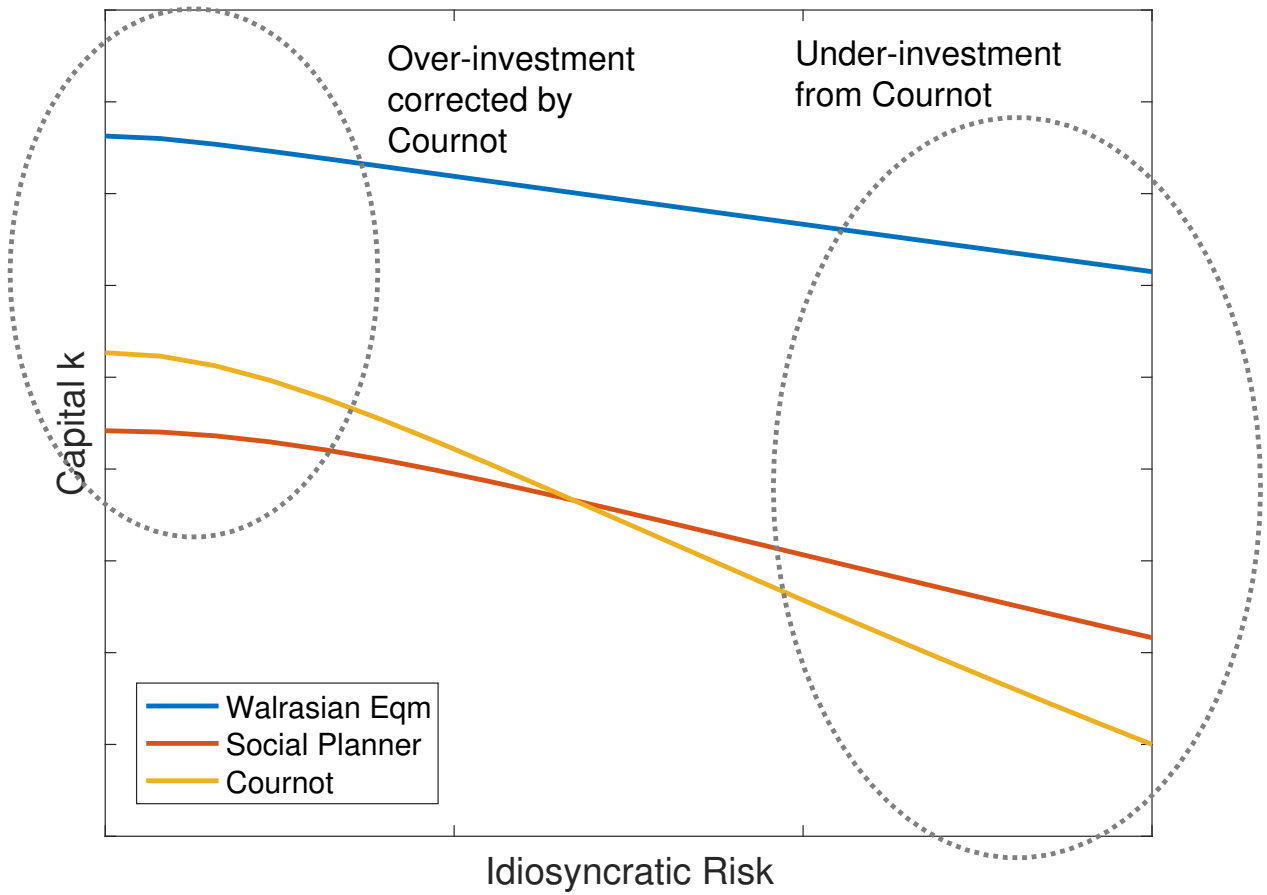

Figure: Idiosyncratic Risk and Over/Underinvestment with Cournot

Production Model

Summary of Results

- With sufficient idiosyncratic risk, Cournot *reverses* externality:
  - leverage and investment below efficient level (*under*-investment)

Conclusion

- Asset-market pricing power can overcorrect or exacerbate externality, depending on source of shocks.
- Incorporating idiosyncratic and aggregate risk critical for understanding how imperfect competition affects pecuniary externalities
  - Price effects differ for buyers and sellers
  - Internalizing price effects separately, rather than as aggregates, can lead to systematic deviations from efficient levels
- So are banks more or less stable now?