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

Motivation 1:

- U.S. banking sector has become extremely concentrated in recent decades
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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?
Motivation 2:

- Many U.S. industries have become extremely concentrated in recent decades and investment is low (compared to $Q$)
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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:
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- Why? Price-taking agents do not internalize how their portfolios depress prices after adverse shocks
Introduction

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  - But a Social Planner always wants higher prices in these models
  - Crucially, how Cournot affects equilibrium depends on types of shocks (asset-side or liabilities-side)
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What we do

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
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We consider two standard macro-finance models:
1. a model of liquidity shocks with illiquid assets
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...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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Why?

- Because there is idiosyncratic risk, buyers and sellers have (potentially) differential price impacts
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Why?

▶ 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
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Why?

- 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
Introduction
Overview of Results

Two main results:

1. Cournot equilibrium may *exacerbate* overinvestment in illiquid assets
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   ▶ Investors hold less liquidity to avoid increasing prices when buyers

2. Cournot equilibrium may *reverse* overinvestment in capital (i.e., under-investment)
   ▶ Investors use less leverage (borrow less and invest in less capital)
   ▶ Investors’ concern about pushing up prices when buying, or down when selling, leads to higher equilibrium prices!
   ▶ And we think these results are the empirically relevant cases if pricing power in asset markets is high
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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

<table>
<thead>
<tr>
<th>Aggregate state</th>
<th>Probability</th>
<th>Liquidity shock</th>
<th>Consumption</th>
<th>Asset price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good state</td>
<td>$\alpha$</td>
<td>Nobody hit</td>
<td>$\bar{c}$</td>
<td>$\bar{p} = R$</td>
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<td>Mixed state</td>
<td>$1 - \alpha$</td>
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<td>$c_L$</td>
<td>$p &lt; R$</td>
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Liquidity Model

Asset price

- Denote fraction invested in liquidity by $\ell$ (hence, $1 - \ell$ in illiquid assets)
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  \[\underbrace{(1 - \ell)p}_{\text{Supply}} = \underbrace{\ell}_{\text{Demand}}\]

  \[\implies p = \frac{\ell}{1 - \ell}.\]

- ($p$ determined by “cash in the market”)

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Liquidity Model
Competitive Equilibrium

- Standard result: efficient allocation holds more liquidity than competitive equilibrium
Liquidity Model
Competitive Equilibrium

- Standard result: efficient allocation holds more liquidity than competitive equilibrium
- 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 $\frac{dp}{d\ell} \frac{1}{p} \beta Ru'(c_H)$

Compared to Walrasian equilibrium, Social Planner considers additional FOC term $\frac{dp}{d\ell} (u'(c_L) - \frac{1}{p} \beta Ru'(c_H)) > 0$

More liquidity/higher price provides liquidity insurance (fire sales depress $p$)
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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 \( \frac{dp_H}{d\ell_i} \frac{1}{p} \beta Ru'(c_H) \)
Liquidity Model

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- Cournot investor has extra FOC term

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\frac{dp_{L}}{d\ell_{i}} u'(c_{L}) - \frac{dp_{H}}{d\ell_{i}} \frac{1}{p} \beta Ru'(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.
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
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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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- Households:
  - no production at $t = 0$
  - 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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- Households:
  - no production at $t = 0$
  - downward sloping demand for capital at $t = 1$ (produce $a \log(1 + k)$ units of goods at $t = 2$, $a \leq 1$)
- At $t = 0$, capital price is $q_0 < 1$ (capital produced from goods at linear rate)
Households are risk-neutral, do not discount, and have deep pockets
Production Model

Preferences

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

$$q_0k = n + d$$
Production Model
Preferences

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

$$q_0k = n + d$$

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

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- Average productivity in the mixed state is low

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

- 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 $A$, capital price is

$$q = a - (q_0 - A) k + n$$

- 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

- Standard result: Social Planner chooses less capital (i.e., less borrowing) to increase capital price in fire sale
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Efficient investment with aggregate and idiosyncratic risk

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  - Benefit of raising price to sellers (low consumption) is always larger than resulting cost to buyers (high consumption)
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  ▶ Benefit of raising price to sellers (low consumption) is always larger than resulting cost to buyers (high consumption)
  ▶ With higher $q$, firms sell less capital to repay debts
  ▶ Less capital misallocated to low-productivity households
Leverage Model
Cournot investment with only aggregate risk

- Without aggregate risk \((A_L = A_H = A)\), all firms sellers in bad state
Leverage Model
Cournot investment with only aggregate risk

- Without aggregate risk ($A_L = A_H = A$), all firms sellers in bad state
- All firms want higher $q$ to minimize fire sales
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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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Cournot investment with aggregate and idiosyncratic risk

- But with sufficient idiosyncratic risk, Cournot price effects depend on buying or selling
Leverage Model
Cournot investment with aggregate and idiosyncratic risk

- But with sufficient idiosyncratic risk, Cournot price effects depend on buying or selling
- When a seller, more capital pushes down price
  - Higher debt $d$
- When a buyer, more capital pushes up price
  - Higher output $A_H$
  - More funds available to buy capital (after repaying debt)
  - Pushes up price
  - which is bad!
- Cournot agents think more marginal capital is always bad
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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*
  \[\implies\text{ Cournot investment below efficient level}\]
Production Model

Investment with aggregate and idiosyncratic risk

**Figure:** Idiosyncratic Risk and Over/Underinvestment with Cournot
Production Model
Investment with aggregate and idiosyncratic risk

Figure: Idiosyncratic Risk and Over/Underinvestment with Cournot
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?