Oligopoly dynamics with financial frictions

Doraszelski, Gomes, and Nockher

Discussion – SFS Cavalcades – May 2023

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This Paper

Understanding the role of financial frictions in duopoly ...

- ... and the role of duopoly on financial friction!
  - Do financial frictions lead to more or less competition and industry investment

Plan

1 The role of financial frictions

2 Comparative statics

Which financial frictions

Frictions to finance investment

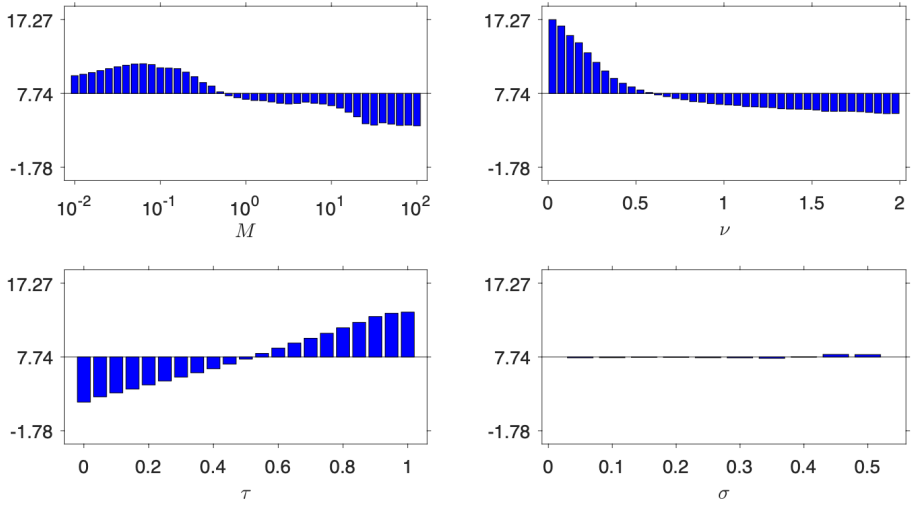
- Convex cost of raising equity
- No savings account

Other interactions of finance with competition

- Barriers to entry (similar to this paper with firms instead of investment)
  - Different type of equilibrium (and techniques)
- Debt overhang (lower investment overall from past liabilities)
- Heterogeneity in frictions

Financial frictions on equilibrium outcomes

Comparative statics: market concentration



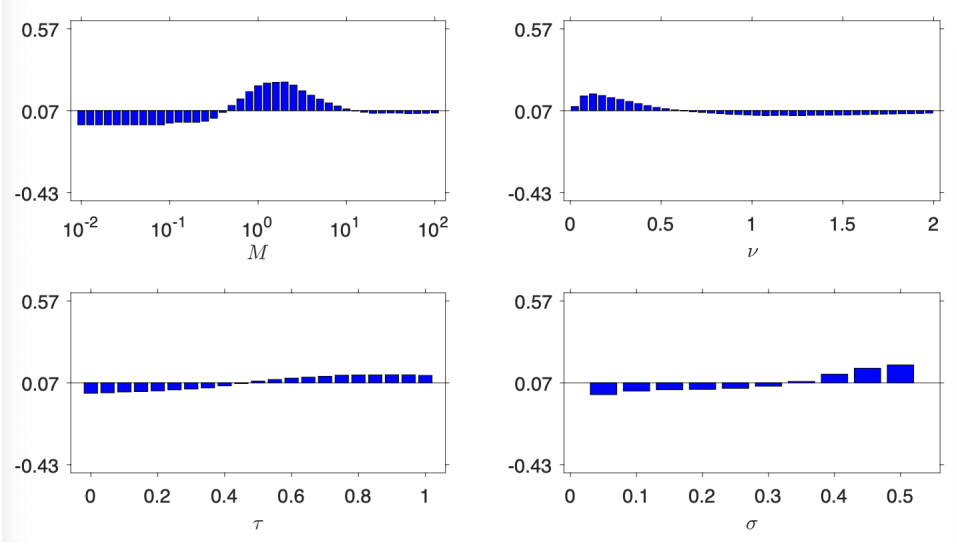
Financial frictions on equilibrium outcomes

Equilibria are more likely to be symmetric when ...

- leader has a handicap $\tau << 1$
- product differentiation ν is high (less ad hoc competition)

Financial frictions on equilibrium outcomes

Comparative statics: price setting



Financial frictions on equilibrium outcomes

Equilibria are more likely to be symmetric when ...

- leader has a handicap $\tau << 1$
- product differentiation ν is high (less ad hoc competition)

Prices are more likely to be lower than without financial constraints when ...

- leader has a handicap $\tau << 1$
- product differentiation ν is high (less ad hoc competition)
- "Accomodating equilibrium"

Note: no general theorem on firm behavior under financial constraints

Plan

1 The role of financial frictions

2 Comparative statics

How to do comparative statics?

Multiple equilibria

- How do we compare results across parameters ...
  - when a set of parameters has 1 equilibrium and the other set has 10,000?
  - when a set of parameters lead to mostly degenerated distribution and the other set does not?

How to do comparative statics? (continued)

First step of comparative statics is to present the equilibria

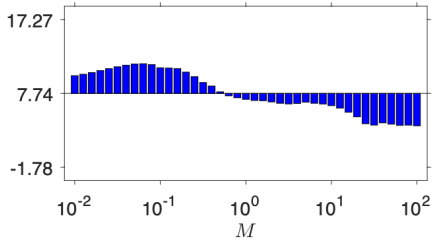
- Fraction of equilibria above an average level

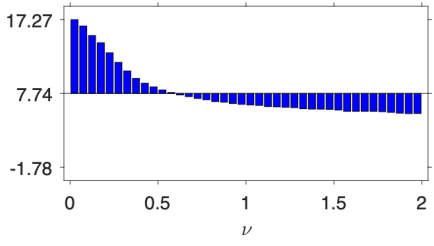
no weight on the likelihood of each equilibrium: all equilibria are equally likely

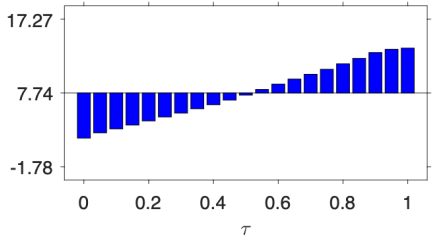
some subset of the parameter space might have more equilibria than others: does this increase dispersion in the results?

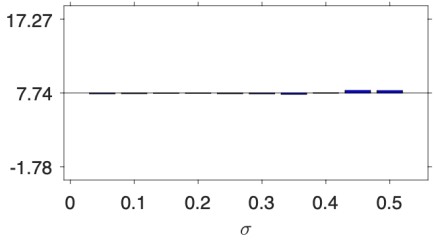
How to do comparative statics? (continued)

Comparative statics: market concentration









How to do comparative statics? (continued)

How does industry concentration change with baseline parameters?

- How does average distance between two firms change with ... market size, horizontal differentiation, leader handicap?
  - **Larger market** size leads to more **symmetric** economies
  - More **product differentiation** (less competitive environment) leads to more **symmetric** economies
  - Stronger **leader advantage** leads to more **concentrated** economies

How to do comparative statics? (continued)

How to do quantitative sensitivity analysis

- For policy or for optimization, decision maker needs to know sensitivity some relevant variable Z of market concentration, or profit to parameters (take s) $\frac{\partial Z}{\partial s}$
- Ex-post: equilibrium selection has happened ... so easy to do on equilibrium path
  - ... this is what we do empirically while we try to control for things that make the equilibrium "special"
- Ex-ante: how do evaluate the effect?
  - Is averaging the elasticity enough?
  - How do we take the derivative across equilibria?

$$\frac{\langle Z \rangle_{s_2} - \langle Z \rangle_{s_1}}{\Delta s} \quad \text{or} \quad \frac{\langle Z_{s_2} - Z_{s_1} \rangle_{s_1 \cup s_2}}{\Delta s}$$

These issues compound with welfare analysis

Interpreting the results

Results take the form of "distributions"

Result 3. *We find that financial frictions: (a) decrease average investment in* **64.7%** *of parameterizations; (b) increase average investment in* **5.9%** *of parameterizations*

Mapping the model to the data

- The model offers the following mapping:

$$\text{parameters } \alpha \xRightarrow{\vartheta} \text{distribution of equilibria} \xRightarrow{\Theta} \text{distribution of statistic } \theta$$

- Classical mapping for a "standard" model:

$$\text{parameters} \xRightarrow{\varphi} \text{statistic}$$

- If we are unsure about some parameters (say we have a distribution)

$$\text{distribution of parameters } g(\alpha) \xRightarrow{\psi} \text{distribution of statistic } f(\theta)$$

Interpreting the results

Using data to estimate parameters

- Classic estimation invert the mapping and parameters as a function of data $\alpha = \varphi^{-1}(\theta)$

$$\text{statistic} \overset{\varphi^{-1}}{\Longrightarrow} \text{parameters}$$

- If we have a distribution to estimate (Bayesian?)

$$\text{distribution of statistic} \overset{\psi^{-1}}{\Longrightarrow} \text{distribution of parameters}$$

- How to estimate this model from a distribution of statistic

$$g(\alpha) = \vartheta^{-1} \circ \Theta^{-1}(f(\theta))$$

  - Sensitivity analysis depends on differential(s) $\nabla(\vartheta^{-1} \circ \Theta^{-1})$
  - Θ is a simple univariate mapping
  - How do we measure the ϑ mapping from parameters to the distribution of equilibria?

Nash equilibrium

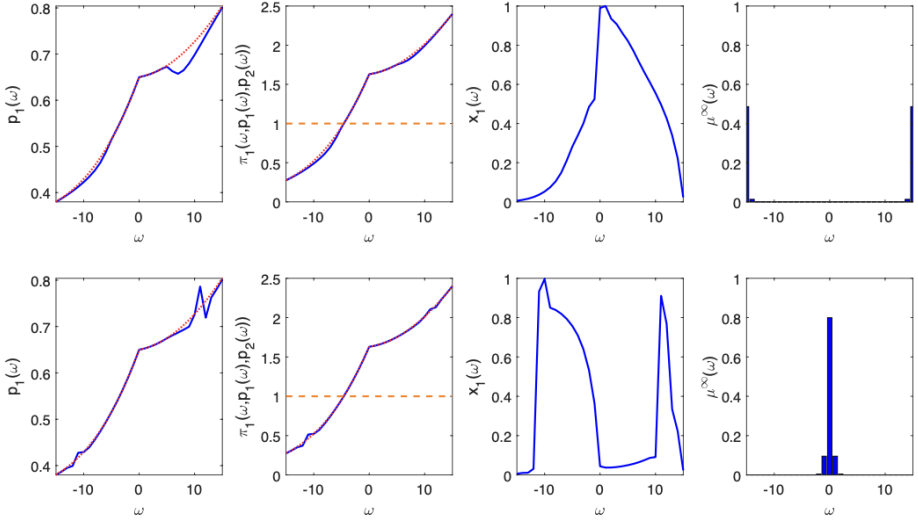
Optimal pricing condition

$$0 = \underbrace{\partial_{p_1}\pi_1}_{\text{static opt.}} + \left(\underbrace{\partial_{x_2}U_1\partial_{\pi_1}x_2}_{\text{competition on } x_2} - \underbrace{F'(\pi_1)x_1}_{\text{direct effect of FC}} \right)\partial_{p_1}\pi_1 + \underbrace{\partial_{p_1}\pi_2 \cdot \partial_{x_2}U_1 \cdot \partial_{\pi_2}x_2}_{\text{competition on } \pi_2}$$

Static Nash

$$0 = \partial_{p_1}\pi_1$$

Nash equilibrium



Nash equilibrium

Benchmark the distribution

- Compare the distribution of outcomes for a parameter set to the Nash equilibrium
- Easier to interpret deviation from standard outcome

- Currently it is hard to understand the dynamic aspect of the model (how I set my price depends on how the distribution of outcomes next period)
  - Deviation from well-understood *separated* equilibrium will shed light on some dynamics

Final Thoughts

Interesting Paper! Go read it.

Take away

- Dynamic duopoly model with financial frictions
- Tour de force of model solving ...
- ... some questions on "statistical analysis"