Oligopolistic Investment, Markups and Asset-Pricing Puzzles

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What We Do...

- Examine the effects of oligopolistic collusion on firm-level capital investment and industry product and asset prices.
- Construct a dynamic production-based, multi-consumption good general equilibrium model with an oligopolistic sector.
- Fit the model to production and asset returns data from 456 U.S. manufacturing industries in the NBER-CES database (for 1958-2011) and U.S. aggregate data.
- Simulate subgame perfect equilibrium paths for 31 highly concentrated and 425 moderately concentrated industries (based on U.S. Census data).

Main Results

- Interaction of aggregate and industry production shocks with dynamic strategic behavior of oligopolistic firms can help explain observed product and asset markets phenomena.
- Theoretically and empirically find
  - Volatilities of capital investment, material inputs, and industry equity risk premia (ERP) are negatively related to product market power.
  - Countercyclical markups in highly concentrated oligopolies, but procyclical markups in moderately concentrated industries.
- Empirically, competition significantly degrades the industry Sharpe ratio.

Main Results

- Model fits reasonably well industry-level volatilities of investment, material inputs, and output in the data.
- The volatility of the multi-good consumption bundle, and hence the volatility of SDF and its covariance with asset returns, is significantly higher compared with the benchmark standard consumption CAPM with time-additive expected utility.
- The industry ERP and its volatility, as well as the maximal Sharpe ratios (Hansen and Jagannathan (1991)) are higher—while the equilibrium risk-free rate (Weil (1989)) is lower—than the benchmark model.

Model Features

- Infinite-horizon, two-sector general equilibrium model in an economy with two consumption goods (x and y).
- One of the goods (x) is "produced" in a large competitive sector through an exogenous Markov process (similar to Lucas (1978)).
- The second good (y) is produced by an oligopolistic sector using capital and materials with a decreasing returns to scale technology.
- The competitive good (x) can be used for consumption or utilized for productive inputs by the oligopolistic sector, which is also exposed to sector-specific Markov productivity shocks.

Model

- The oligopoly sector has N firms. All firms use an identical production technology

$$F(K_{it}, H_{it}, \theta_t) = \theta_t (K_{it})^{\psi_K} (H_{it})^{\psi_H}, \;\; i = 1, ..., N$$

  - θ_t is stochastic industry-wide productivity level
  - K_{it} capital and H_{it} is material input
  - $\psi_K + \psi_h \leq 1$
- Sector y uses x for capital and material inputs
  - x is directly converted to material input so that the total material cost is H_{it}
  - cost of converting x to investment is

$$A(I_{it}, K_{it}) = I_{it} + 0.5\upsilon \left(\frac{I_{it}}{K_{it}} \right)^2 K_{it}$$

Model

- The firms capital accumulation process is

$$K_{it+1} = (1-\delta)K_{it} + I_{it}, K_{i0} = \bar{K}_{i0}$$

- X_t and θ_t processes are

$$\log X_t = \rho_x \log X_{t-1} + \varepsilon_t^x; \log \theta_t = \rho_\theta \log \theta_{t-1} + \varepsilon_t^\theta$$

- Dividends of firms in sector y are

$$D_{it}^y = p_t^y Y_{it} - H_{it} - A(I_{it}, K_{it}), \;\; i = 1, ..., N$$

- Representative consumer has time separable expected utility of the constant elasticity of substitution (CES) form.

Model Implications

- We analyze symmetric subgame perfect equilibrium (SPE) oligopolistic paths with simultaneous clearing of product and asset markets.
- Oligopolistic firms strategically adapt investment and material input demand in response to aggregate or sectoral shocks to moderate their effects on the general equilibrium industry price.
- Product market power tends to "smooth out" the effects of aggregate and industry shocks on optimal investment, material inputs, and hence dividend payouts compared with competitive firms in identical settings.
- Heterogeneous consumption of manufacturing and non-manufacturing goods helps explain the excess volatility and equity premium puzzles.

Calibration and Simulations

- From NBER-CES database we get annual data on 456 industries for 1958-2011.
- Of these, 31 industries (6.8% of the total) satisfy our definition of highly concentrated oligopolies—that is, where the top 4 firms generate more than 70% of the output.
- For each concentration group, we derive data measuring the model variables.
- Output of the non-oligopolistic "aggregate" sector is the difference between the *aggregate* output of all sectors obtained from the US Bureau of Economic Affairs (BEA) and the output of the group.

Calibration and Simulations

- For sectoral financial variables, we first map the 1997 NAICS codes to 1987 Standard Industry Classification (SIC) codes.
- We then use four-digit SIC codes to compute the (value-weighted) sectoral portfolio returns.
- Financial variables for the aggregate sector are derived using the annual CRSP value-weighted index returns as the proxy.
- We derive quantitative implications of the model using both log-linear techniques and global solutions that take into account the nonlinearities of the model.

Calibration Results: Moderately Concentrated Industries

Product Market Variables

	Data	Oligopoly $\gamma = 10$	Competitive $\gamma = 10$	Oligopoly $\gamma = 7.5$
Vol(ε^X)	3.12%	3.20%	3.24%	3.20%
Vol(ε^θ)	2.07%	2.11%	2.12%	2.12%
Mean($pmcr$)	1.2	1.2	1.0	1.2
Vol(g_I)	9.72%	14.29%	29.64%	14.29%
Vol(g_H)	4.26%	4.28%	4.40%	4.28%
Vol(g_Y)	4.26%	5.66%	5.86%	5.65%
Corr(g_I, g_X)	0.62	0.68 (0.0)	0.51 (0.0)	0.66 (0.0)
Corr(g_I, g_θ)	0.31	0.66 (0.0)	0.62 (0.0)	0.67 (0.0)
Corr(g_H, g_X)	0.82	0.62 (0.0)	0.60 (0.0)	0.62 (0.0)
Corr(g_H, g_θ)	0.63	0.77 (0.0)	0.75 (0.0)	0.77 (0.0)
Corr(g_{pmcr}, g_X)	0.83	0.09 (0.0)	0.0 (0.0)	0.08 (0.0)

Calibration Results: Moderately Concentrated Industries

Asset Market Variables

	Data	Oligopoly $\gamma = 10$	Competitive $\gamma = 10$	Oligopoly $\gamma = 7.5$
$\text{Vol}(\varepsilon^X)$	3.12%	3.20%	3.20%	3.20%
$\text{Vol}(\varepsilon^\theta)$	2.07%	2.12%	2.12%	2.12%
$\text{Mean}(pmcr)$	1.2	1.2	1.0	1.2
$\mathbb{E}(r^y - r^f)$	5.93%	2.65%	3.97%	1.75%
$\mathbb{E}(r^x - r^f)$	5.55%	1.41%	1.44%	0.94%
$\text{Vol}^u(r^y - r^f)$	16.10%	11.40%	18.73%	10.82%
$\text{Vol}^u(r^x - r^f)$	15.69%	5.02%	5.10%	4.58%
$\frac{\mathbb{E}(r^y - r^f)}{\text{Vol}^u(r^y - r^f)}$	0.37	0.23	0.21	0.16
$\frac{\mathbb{E}(r^x - r^f)}{\text{Vol}^u(r^x - r^f)}$	0.35	0.28	0.28	0.21
$\mathbb{E}(r^f)$	1.36%	3.00%	2.99%	3.00%

Calibration Results: Highly Concentrated Industries

Product Market Variables

	Data	Oligopoly $\gamma = 10$	Competitive $\gamma = 10$	Oligopoly $\gamma = 7.5$
Vol(ε^X)	3.20%	3.24%	3.30%	3.24%
Vol(ε^θ)	1.90%	1.94%	1.90%	1.94%
Mean($pmcr$)	1.5	1.5	1.00	1.5
Vol(g_I)	17.69%	19.50%	26.07%	19.22%
Vol(g_H)	7.84%	3.49%	3.67%	3.48%
Vol(g_Y)	7.12%	4.57%	4.85%	4.55%
Corr(g_I, g_X)	0.45	0.61 (0.0)	0.55 (0.0)	0.60 (0.0)
Corr(g_I, g_θ)	0.13	0.65 (0.0)	0.60 (0.0)	0.66 (0.0)
Corr(g_H, g_X)	0.68	0.54 (0.0)	0.52 (0.0)	0.54 (0.0)
Corr(g_H, g_θ)	0.62	0.63 (0.0)	0.59 (0.0)	0.63 (0.0)
Corr(g_{pmcr}, g_X)	-0.41	-0.07 (0.0)	0.0 (0.0)	-0.07 (0.0)

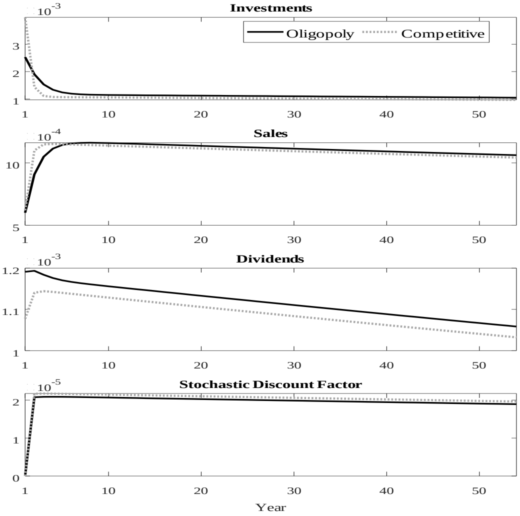
Calibration Results: Highly Concentrated Industries

Asset Market Variables

	Data	Oligopoly $\gamma = 10$	Competitive $\gamma = 10$	Oligopoly $\gamma = 7.5$
$\text{Vol}(\varepsilon^X)$	3.20%	3.24%	3.24%	3.24%
$\text{Vol}(\varepsilon^\theta)$	1.90%	1.94%	1.94%	1.94%
$\text{Mean}(pmcr)$	1.5	1.5	1.00	1.5
$\mathbb{E}(r^y - r^f)$	5.09%	1.49%	3.86%	0.99%
$\mathbb{E}(r^x - r^f)$	5.55%	1.49%	1.55%	0.99%
$\text{Vol}^u(r^y - r^f)$	18.28%	5.46%	19.20%	5.00%
$\text{Vol}^u(r^x - r^f)$	15.69%	5.10%	5.19%	4.61%
$\frac{\mathbb{E}(r^y - r^f)}{\text{Vol}^u(r^y - r^f)}$	0.28	0.27	0.20	0.20
$\frac{\mathbb{E}(r^x - r^f)}{\text{Vol}^u(r^x - r^f)}$	0.35	0.29	0.30	0.21
$\mathbb{E}(r^f)$	1.36%	2.99%	2.99%	3.0%

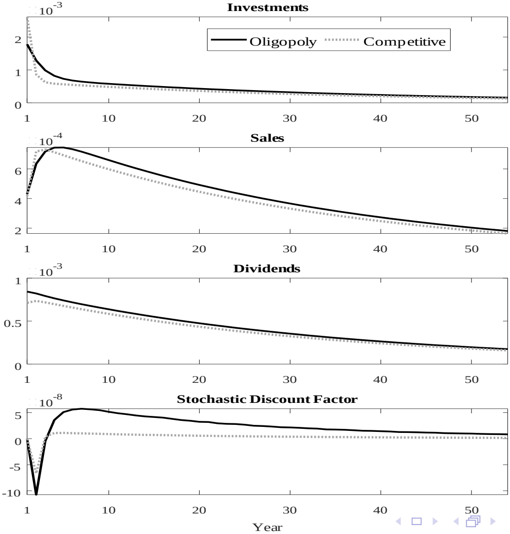
Highly Concentrated Industries

Impulse Response Function (X)



Highly Concentrated Industries

Impulse Response Function (θ)



Conclusion

- The role of oligopolistic collusion in transmitting the effects of aggregate and industry shocks on industry and aggregate real and financial outcomes is of substantial interest.
- A dynamic production-based general equilibrium multi-consumption good model with an oligopolistic industry, fitted to U.S. aggregate and manufacturing industry data, matches second moments of investment, material inputs, output, and markups reasonably well.
- The multi-consumption good setting along with investment helps explain the mean industry ERP and its volatility, as well as the Sharpe ratio.
- The empirical analysis is consistent with theoretical predictions on the relation of the second moments of real and asset market variables with industry competition.

Full Paper Link

- The link for the full paper is below.

Link