Q: risk, rents, or growth?

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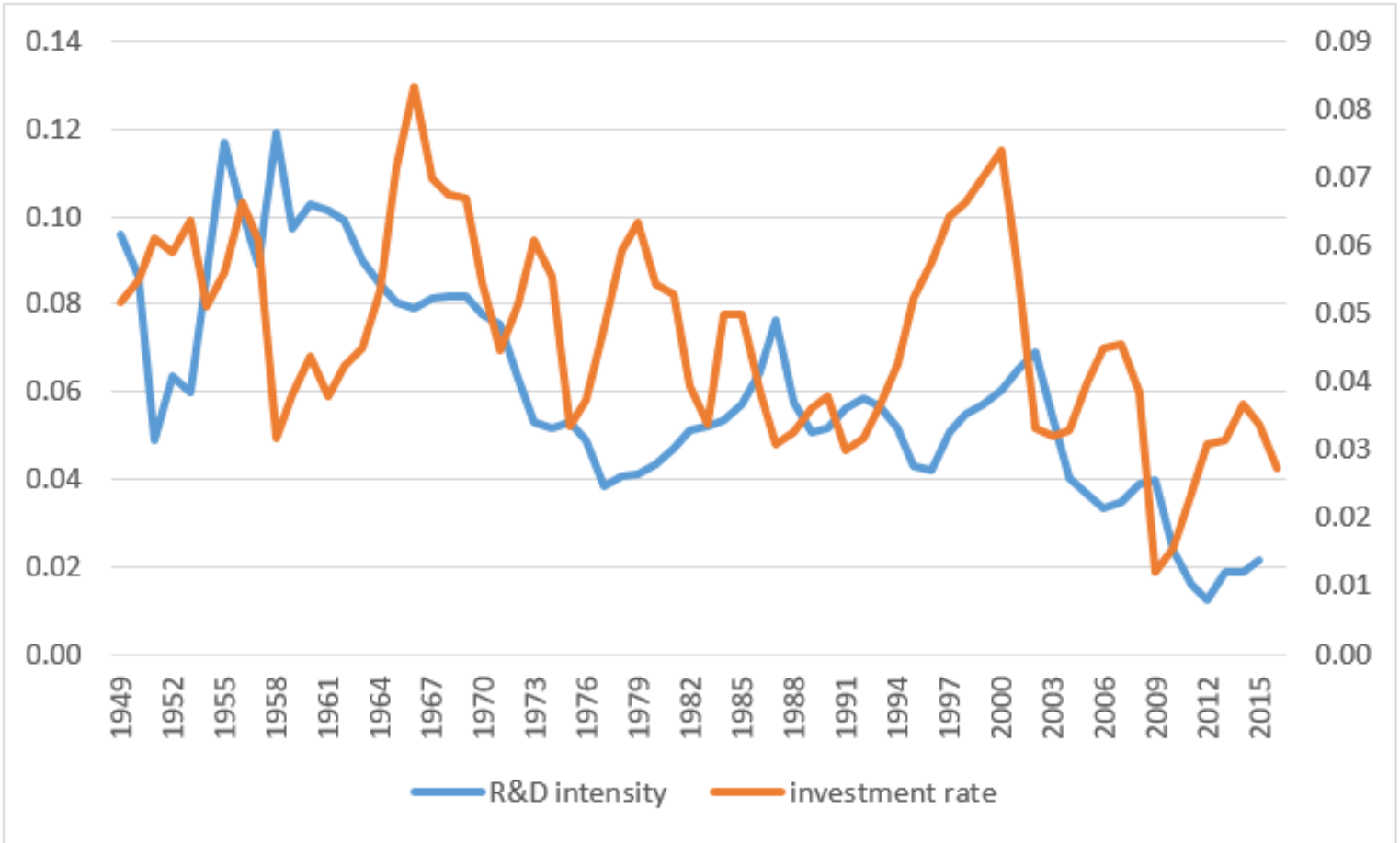
Secular trends

- Secular trends in aggregate economic activity:
  - average output growth and productivity have declined 2.38% (1984-2000) to 1.08% (2001-2017)
  - capital investment and innovation have dropped

Investment and innovation



- Secular fall in investment and innovation over the past few decades

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  - average output growth and productivity have declined 2.38% (1984-2000) to 1.08% (2001-2017)
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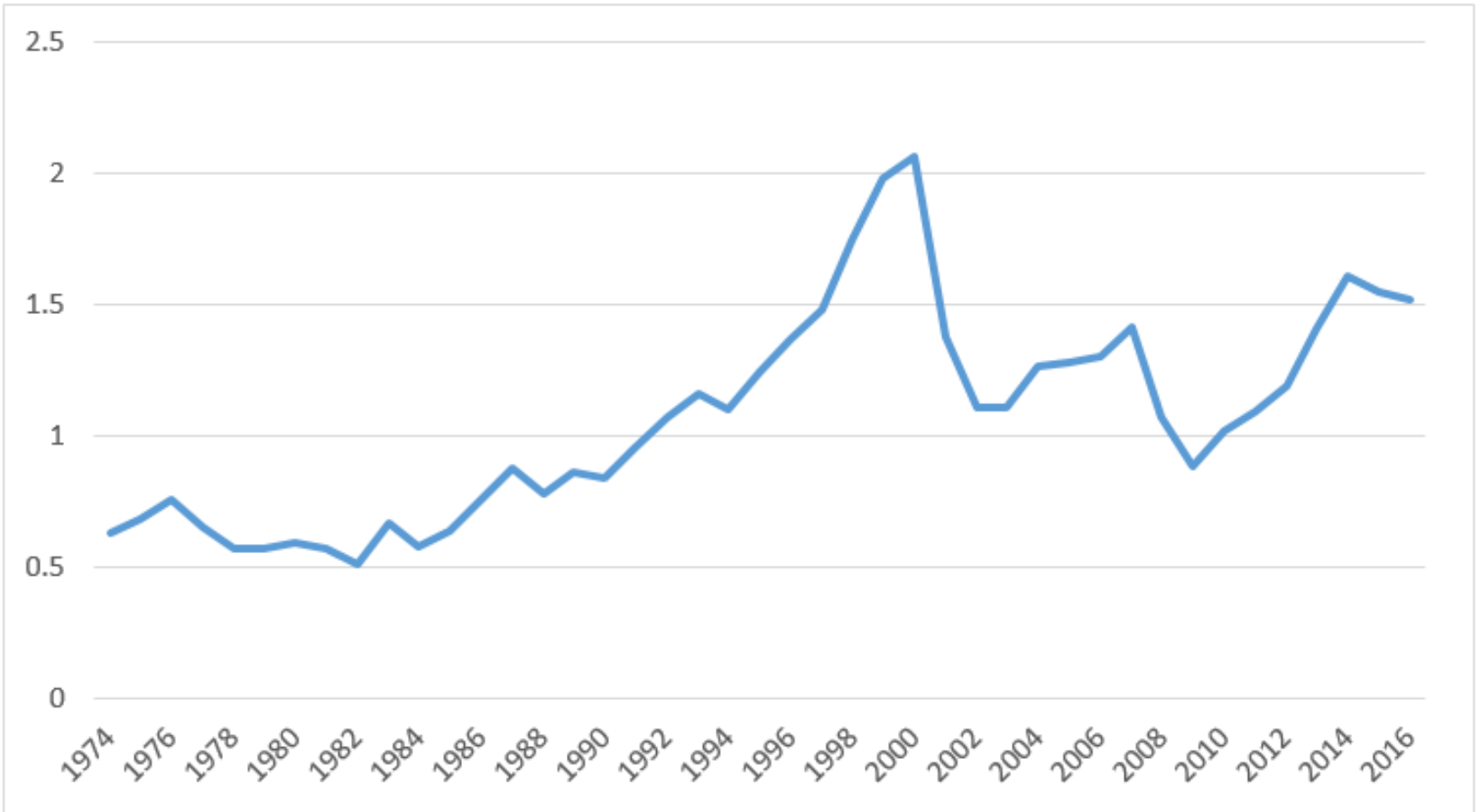
- Secular trends in asset valuation:
  - increase in corporate profits
  - high valuation ratios over the period

Q



- Tobin's Q had been rising over the same period

Secular trends

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  - average output growth and productivity have declined 2.38% (1984-2000) to 1.08% (2001-2017)
  - capital investment and innovation have dropped
- Secular trends in asset valuation:
  - increase in corporate profits
  - high valuation ratios over the period
- Increase in Tobin's Q was followed by a large correction in March 2020 and a prompt recovery.

Q: Risk, Rents, or Growth?

$$Q = \frac{V}{K} \approx 1 + \frac{ROA}{R - g}$$

1. ROA
   - Rents? Competition?
   - Returns to intangible capital?
2. R
   - Interest rates?
   - Risk premia?
3. g
   - Innovation?

Q: Risk, Rents, or Growth?

$$Q = \frac{V}{K} \approx 1 + \frac{ROA}{R - g}$$

1. ROA
   - Rents? Competition? (e.g. Gutierrez and Philippon (2018))
   - Returns to intangible capital? (e.g. Crouzet and Eberly (2018))
2. R
   - Interest rates? (e.g. Eggertson et al. (2018))
   - Risk premia? (e.g. Farhi and Gourio (2018))
3. g
   - Innovation? (e.g. Bloom et al. (2018))

▷ Endogenous linkages between these forces?

This paper: provide a quantitative decomposition of the drivers behind these trends using an estimated general equilibrium model with endogenous growth, endogenous competition, and realistic risk premia

Roadmap

- Model
- Estimate the model, using SMM, in two sub-periods
  - 1984-2000 (high i, low valuations/profits, high r)
  - 2001-2017 (low i, high valuations/profits, low r)
- Isolate effect of changes in key structural parameters
- Extension with sticky prices

Key model features

1. Endogenous concentration:
   - firms compete in oligopolistic industries
   - new firms can enter and disrupt incumbents rents
   - creates time-varying markups
2. Endogenous growth:
   - firms can improve their productivity by investing in R&D
   - through spillover effects: innovation policies affect aggregate growth
3. Recursive preferences:
   - movements in long-run rates are priced

$\Rightarrow$ Changes in the competitive environment can affect long-term growth and risk and vice-versa.

Results highlights

- Model rationalizes many secular trends in the data.
  - $\uparrow$ concentration, $\uparrow$ markup, $\downarrow$ labor share
  - $\downarrow$ productivity, investment and innovation
  - $\uparrow$ Tobin's Q
  - $\downarrow$ risk-free rate and inflation
  - etc.
- Explain the increased sensitivity of asset prices and economic activity to shocks (monetary policy, demand, uncertainty, etc.)
- Large role attributed to rising entry costs.
- Increase in price markup has had important effects on risk and growth:
  - consumption growth: ≈ -51 *bps*
  - risk-free rate: ≈ -50 *bps*
  - equity premium: $\approx +43$ *bps*
  - welfare loss: $\approx +27\%$

Economic environment

- ▷ Households: rep agent, Epstein-Zin preferences
- ▷ Production structure:
  1. final goods: competitive
  2. industries: bounded measure of differentiated firms, free entry
     - firms compete oligopolistically
- ▷ Only one exogenous shock to technology.

Industry structure

- Each industry uses a measure $N_{j,t}$ of firm's output to produce an industry good $Y_{j,t}$:

$$Y_{j,t} = \left(\int_0^{N_{j,t}} X_{ij,t}^{\frac{\nu_2 - 1}{\nu_2}} \, di \right)^{\frac{\nu_2}{\nu_2 - 1}},$$

  a. ν_2 is the elasticity of substitution between intermediate goods
  b. $N_{j,t}$ is the *time-varying* mass of firms in an industry.

Industry structure

- Industries are characterized by an oligopolistic market structure. Firms play each period a *Bertrand game* within their industry, i.e. firms set price taking as given the decisions of other firms.
  - $\Rightarrow$ the intensity of competition depends on the number of firms within each industry.
- The price elasticity of demand:

$$\xi_{j,t} = \frac{-\nu_2 N_{j,t} + \nu_2 - \nu_1}{N_{j,t}}$$

- Converges to standard Dixit-Stiglitz elasticity in the limit:

$$\lim_{N_{j,t} \to \infty} \xi_{j,t} = -\nu_2.$$

Firms

- Uses labor and physical and intangible capital as inputs (suppressing industry and intermediate good subscripts):

$$X_t = K_t^{\alpha} \left(TFP_t \cdot L_t \right)^{1-\alpha}$$

- Total factor productivity:

$$TFP_t \quad \equiv \quad A_t Z_t^{\eta} \mathcal{Z}_t^{1-\eta},$$

  where $\mathcal{Z}_t$ is the total aggregate stock of intangible capital.

- The spillover effects from R&D investment lead to sustained endogenous growth.

Firms

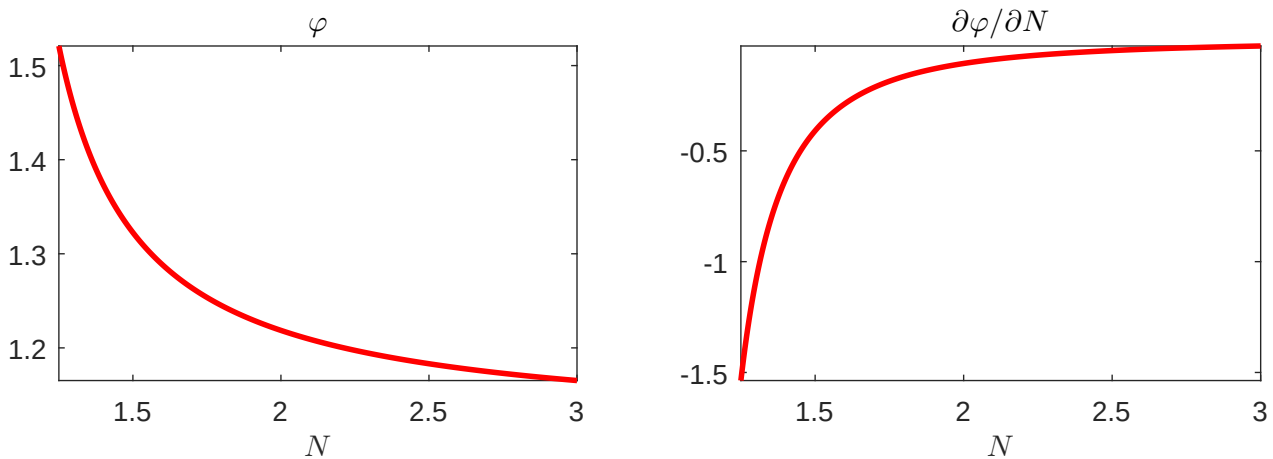
- Firm's problem:

$$\max_{L_t, K_t, Z_t, P_t} D_t \quad = \quad P_t X_t - W_t L_t - r_t^k K_t - r_t^z Z_t$$

s.t. firm demand function and taking decisions of other firms as given.

- In equilibrium, the price markup φ_t depends on the number of firms:

$$\varphi_t \quad = \quad \frac{-\nu_2 N_t + (\nu_2 - \nu_1)}{-(\nu_2 - 1) N_t + (\nu_2 - \nu_1)}$$



Entry & exit

- Entry in the industry entails a fixed cost:

$$F_{E,t} = \kappa \mathcal{Y}_t$$

- Law of motion for number of firms in an industry:

$$N_{t+1} = (1 - \delta_n)(N_t + N_{E,t})$$

  where δ_n is the firm exit rate, and $N_{E,t}$ is entry.

- The equilibrium number of firms is determined by a free entry condition:

$$(1 - \delta_n) E_t[\mathcal{M}_{t+1} V_{t+1}] = F_{E,t}$$

Endogenous links: markup, growth, and risk

$$\frac{RDX}{Sales} = \frac{\mathcal{R}_t^z Z_t}{P_t X_t} = \frac{\eta(1-\alpha)}{\varphi_t}$$

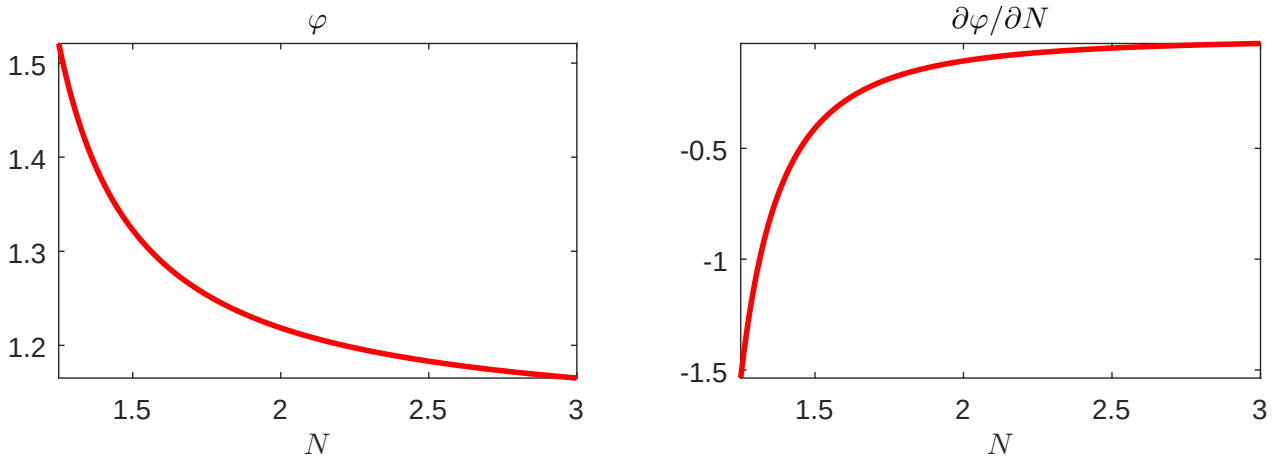
- Incentives for entry are related to expected profits
  $\Rightarrow$ entry (and competition) is *procyclical*.
  $\Rightarrow$ markups are *countercyclical*.
- Further reduces demand for R&D in recessions, which amplifies downturns

Endogenous links: markup, growth, and risk

- Equilibrium TFP depends on the accumulation of R&D capital:

$$\begin{aligned} E_t[\Delta tfp_{t+1}] &\approx \Delta z_{t+1} \\ &\approx -\delta_z + \log(\text{R\&D intensity}). \end{aligned}$$

- creates low-frequency movements in growth rates which are a source of *equilibrium long-run risks*.
  - with EZ preferences $\Rightarrow$ sizeable risk premia.
- Allowing for endogenous price markups amplifies this relation.



Estimation

- ▷ Estimate 7 potential candidate drivers of secular trends over two subsamples (1984-2000 and 2001-2017) via SMM.
- ▷ Estimated parameters:
  - δ_k, δ_z: depreciation rates of physical and intangible capital
    $\longrightarrow$ use empirical depreciation rates.
  - η: is the share of technology in the production function
    $\longrightarrow$ identified using the ratio of intangible to physical capital.
  - β: subjective discount factor
    $\longrightarrow$ primarily identified using the 1-year real yield.
  - κ: entry cost parameter
    $\longrightarrow$ aggregate markup measure from Eeckhout and DeLoecker (2018)
  - $a^\star$: average level of productivity
    $\longrightarrow$ match mean output growth.
  - γ: risk aversion
    $\longrightarrow$ match PE ratio.

Parameter estimates

Panel A: Moments

	Data		Model	
	1984-2000	2001-2017	1984-2000	2001-2017
Mean output growth	2.38%	1.08%	2.38%	1.08%
Mean risk-free rate	3.13%	-0.48%	3.13%	-0.48%
Mean markup	37.56%	47.75%	37.68%	47.87%
$E[\delta_k]$	1.79%	1.72%	1.79%	1.72%
$E[\delta_z]$	7.02%	7.27%	7.02%	7.27%
Mean Z/K	6.28%	10.82%	6.28%	10.82%
Mean PE	19.41	24.54	19.38	24.48

Panel B: Parameter estimates

	$a^\star$	β	η	γ	$\bar{\kappa}$	δ_k	δ_z
1984-2000	1.030	0.988	**0.072**	8.467	**2.301**	1.79%	7.02%
2001-2017	0.272	0.994	**0.155**	9.813	**4.078**	1.72%	7.27%
Difference	-0.758	0.005	**0.083**	1.346	**1.776**	-0.07%	0.25%

- ▷ The model matches the trend in the target moments very well.
- ▷ Share of intangible and entry cost have subtantially increased.

Parameter contribution in explaining trends

	$a^\star$	β	η	γ	κ	δ_k	δ_z
HHI	0.02	-0.02	-0.00	0.00	0.11	0.00	-0.00
n	-0.03	0.03	0.01	-0.00	-0.19	-0.00	0.00
Profit Share	1.56%	-0.29%	-4.84%	0.05%	7.00%	0.22%	-0.04%
B. Macro moments							
$E[\Delta y]$	-2.44%	1.28%	0.32%	-0.14%	-0.51%	-0.11%	0.03%
$\sigma[\Delta y]$	-0.12%	0.10%	-0.08%	-0.00%	0.09%	-0.02%	0.02%
$E[\Delta tfp]$	-2.44%	1.28%	0.32%	-0.14%	-0.51%	-0.11%	0.03%
$\sigma[\Delta tfp]$	-0.09%	0.03%	-0.04%	-0.00%	0.06%	-0.02%	0.02%
Net I/K	-2.45%	1.29%	0.32%	-0.15%	-0.51%	-0.11%	0.03%
Net S/Z	-2.45%	1.29%	0.32%	-0.15%	-0.51%	-0.11%	0.03%
Labor Share	-0.01	0.01	0.00	-0.00	-0.04	-0.00	0.00
C. Asset prices							
$E[r_f^{(1)}]$	-0.08%	-2.86%	0.33%	-0.56%	-0.50%	0.09%	-0.07%
$E[r_d - r_f]$	-1.14%	1.34%	-0.22%	0.75%	0.43%	-0.15%	0.10%
$E[r_d]$	-1.31%	-1.45%	0.08%	0.23%	-0.06%	-0.07%	0.04%
$E[Q]$	-0.03	0.03	-0.17	0.00	0.24	-0.00	0.00
$\sigma[r_d - r_f]$	-0.14%	0.08%	0.04%	0.00%	0.12%	-0.02%	0.03%

- Rising markups are key to explain:
  - joint rise in Q and fall in R&D and investment.
  - the increase in competition and profitability measure.

Effects of the rise of market power cont.

Panel B: Markup contribution to target moments

	1984-2000	2001-2017	Difference	Contribution
$E[\Delta y]$	2.38%	1.08%	-1.30%	-0.51%
$E[r_f]$	3.13%	-0.48%	-3.60%	-0.50%
$E[r_d - r_f]$	2.01%	3.50%	1.48%	0.43%

- Rising markups explains a significant portion of:
  - the fall in productivity and growth.
  - the fall in risk-free rate and rising equity risk premium.
  - lead to a significant welfare loss $\approx 27\%$
- Accounting for endogenous markup and growth is key to explain observed secular trends.

Risk, rents, and growth nexus

Table: Markup contribution

	I. Benchmark	II Exo growth&markup
Markup	10.19%	10.19%
E[Δy]	-0.51%	0.00%
$\sigma[\Delta y]$	0.09%	0.00%
E[r_f]	-0.50%	-0.03%
E[$r_d - r_f$]	0.43%	0.20%
Welfare costs	27%	1%

- ▷ Critical to account for endogenous linkages between markups, growth, and risk.

Robustness checks

The quantitative importance of rising entry costs is robust to:

1. estimating capital share changes across sample
2. using a demand-side measure for industry competition – total number of operating firms.

$$\varphi_t \quad = \quad \frac{-\nu_2 N_t + (\nu_2 - \nu_1)}{-(\nu_2 - 1) N_t + (\nu_2 - \nu_1)}$$

3. allowing parameters to slowly adjust over time.

Nominal trends

- Extend the model with sticky prices.

$$D_t = P_t X_t - \mathcal{W}_t L_t - R_{k,t} K_t - R_{z,t} Z_t - \frac{\Phi_P}{2} \left(\frac{P_t}{P_{t-1} \bar{\Pi}} - 1 \right)^2 \bar{\mathcal{Y}}_t$$

- Price markup varies over time because of
  - industry competition
  - aggregate inflation

$$\varphi_t^{-1} = \frac{-(\nu_2 - 1) N_t + (\nu_2 - \nu_1)}{-\nu_2 N_t + (\nu_2 - \nu_1)} + \Phi_P \frac{-\left(\frac{\Pi_{j,t}}{\bar{\Pi}} - 1 \right) \frac{\Pi_{j,t}}{\bar{\Pi}} + E_t \left[(1 - \delta_n) M_{t,t+1} \left(\frac{\Pi_{j,t+1}}{\bar{\Pi}} - 1 \right) \frac{\Pi_{j,t+1}}{\bar{\Pi}} \Delta \mathcal{Y}_{t+1} \Delta \mathcal{N}_{t+1} \right]}{1 - \nu_2 + (\nu_2 - \nu_1) N_t^{-1}}$$

$\Rightarrow$ Amplifies the countercyclicality of markups.

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Mean Z/K	6.28%	10.82%	6.28%	10.82%
Mean PE	19.41	24.54	19.41	24.52
Mean inflation	3.20%	2.06%	3.20%	2.06%

Panel B: Parameter estimates

	$a^\star$	β	η	γ	$\Pi^\star$	$\bar{\kappa}$	δ_k	δ_z
1984-2000	1.016	0.988	0.072	8.636	1.025	2.074	1.79%	7.02%
2001-2017	0.261	0.994	0.156	10.112	1.028	3.743	1.72%	7.27%
Difference	-0.755	0.005	0.084	1.476	0.002	1.669	-0.07%	0.25%

- Model matches the fall of inflation.

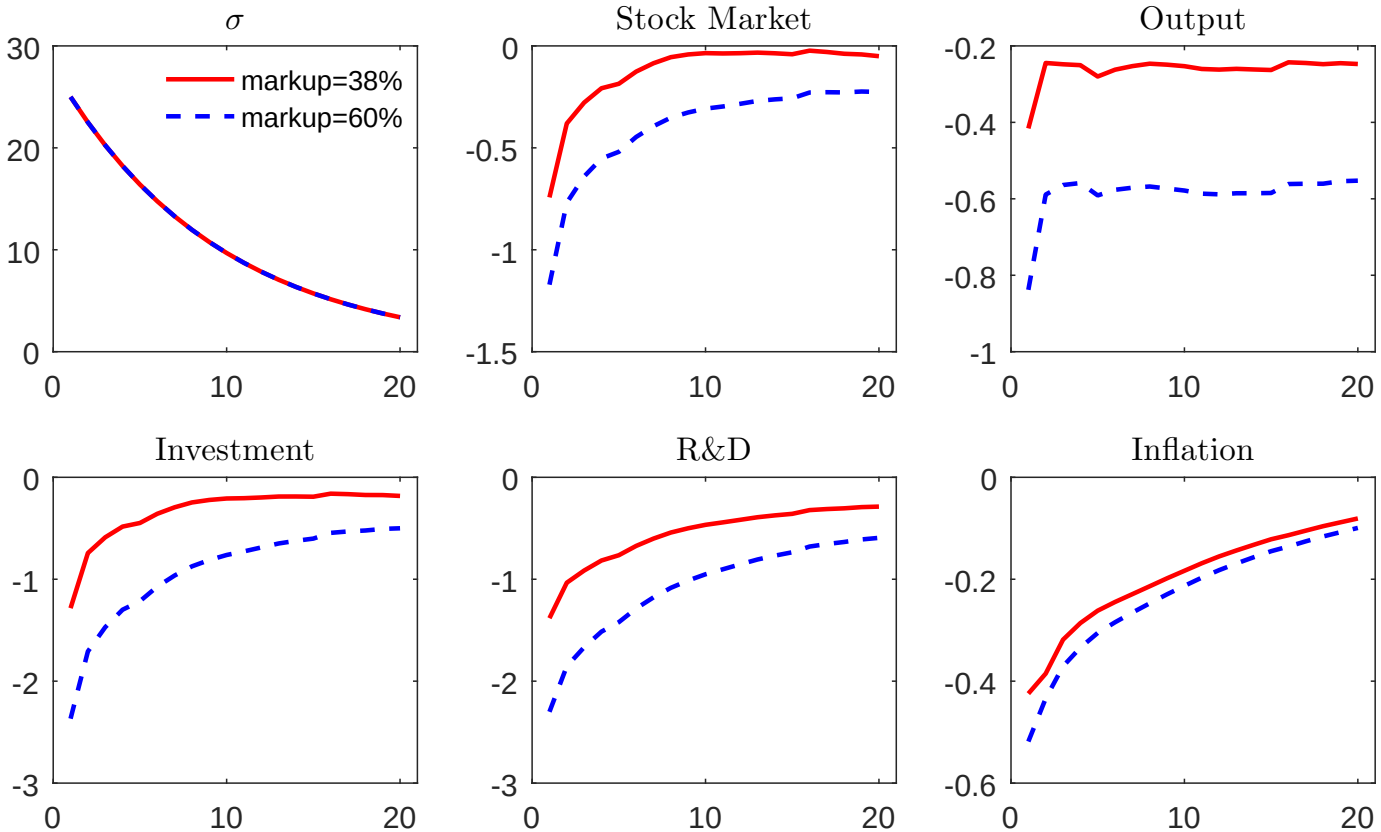
Risk, rents, and growth nexus - nominal rigidities

	I. Benchmark	II. Nominal rigidities
Markup	10.19%	10.19%
$E[\Delta y]$	-0.51%	-0.60%
$\sigma[\Delta y]$	0.09%	0.10%
$E[r_f]$	-0.50%	-0.70%
$E[r_d - r_f]$	0.43%	0.51%
$E[\pi]$	-	-1.11%
$\sigma[\pi]$	-	-0.15%

- Role of markups increased with nominal rigidities.
- Rise in markups explain 'missing inflation puzzle' and the secular trend in inflation volatility.

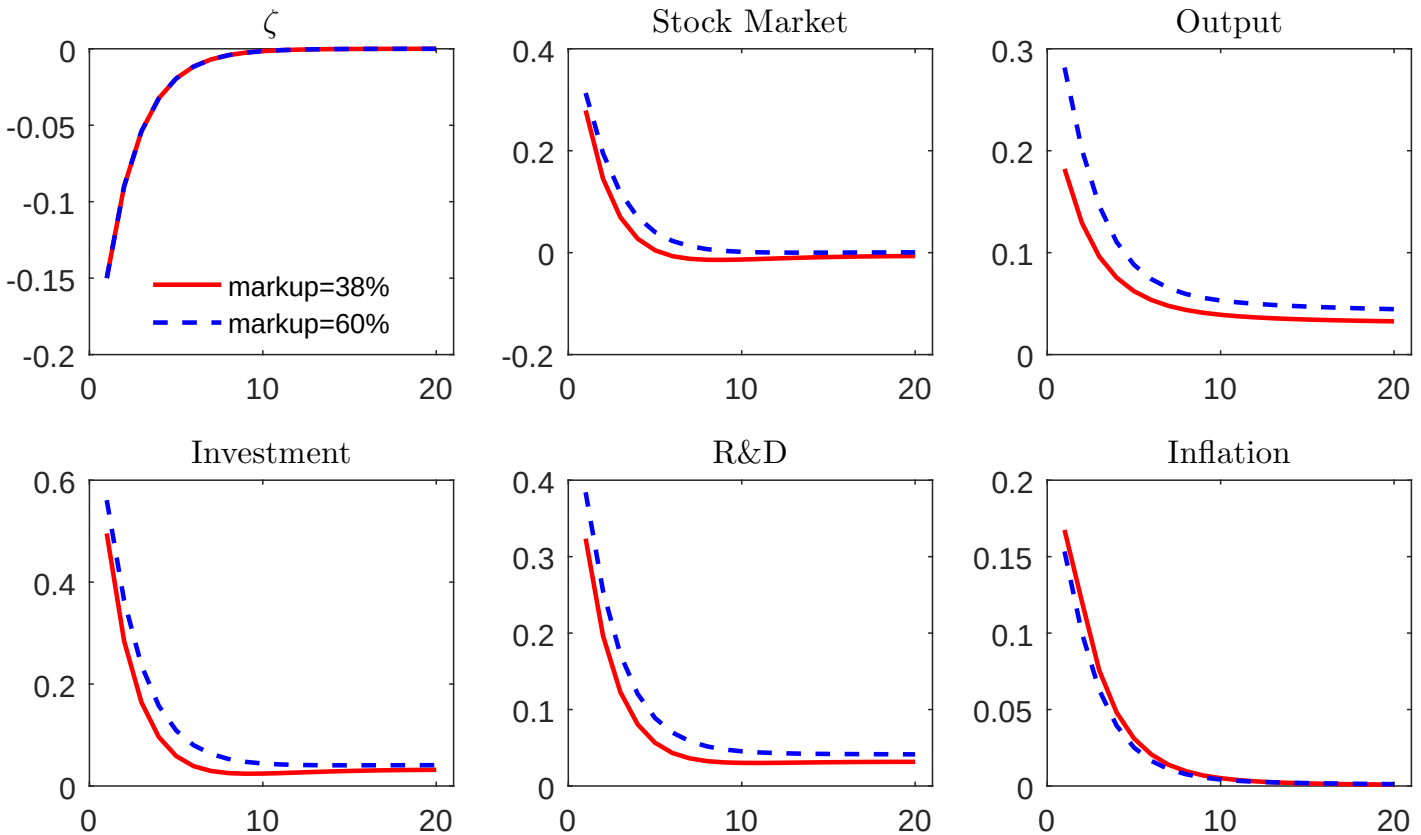
  Intuition:
  - Sticky prices make markup "too high" in recessions relative to the desired markup.
  - recessions are times of high price of risk.
  - firms are reluctant to increase price $\Rightarrow$ lower inflation
  - higher markups amplify this effect.

Higher markups and responses to shocks



- Stock market valuations and the economy are more sensitive to shocks in high markup environment.
  - consistent with large market correction in March 2020.

Monetary policy shocks



▷ Economy and asset markets more sensitive to monetary policy shocks.

Conclusion

- We estimate a model that allows for rich interactions between market structure, growth and risk.
  - time-varying markups play a central role in the economy
- Fall in competition is a key driver of recent macroeconomic trends and has an important impact on welfare.
- Policy makers should pay a close attention to the enforcement of antitrust laws.