Market Power in the U.S. Airline Industry, 1990-2019

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Motivation

- Recent work: markups and concentration have increased across many agg. sectors of the U.S. and global economy
  - Key concern in industrial organization and competition policy
  - Macro: pervasive effects may extend to other markets and the aggregate economy
- Different potential explanations: demand, costs, and conduct
  - Industry-level research focused on trends in markups is needed to understand where they are rising and why
- **This paper:** studies evolution of market power in the U.S. airline industry and causes behind this evolution

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  - Fewer number of firms facilitates collusion
  - American-US Airways merger raised concerns about coordinated effects (Olley and Town 2019, Porter 2020)

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  - American-US Airways merger raised concerns about coordinated effects (Olley and Town 2019, Porter 2020)
- Highly volatile environment (agg. demand and supply shocks), expansion of low-cost carriers (LCC)

This Paper: Part I

1. Document the evolution of market power in the industry for the period 1990:Q1-2019:Q4

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1. Document the evolution of market power in the industry for the period 1990:Q1-2019:Q4
   - Obtain estimates of markups (i.e., P/MC) for each airline-time
   - Use production data and production approach to markup estimation (Hall 1988 and De Loecker and Warzynski 2012)
     - allows me to overcome the weak instruments problem when estimating conduct/markups using a demand approach
   - Assess role of technology vs. profitability in evolution of markups

This Paper: Part II

2. Study the role of coordinating behavior

   - Test if airline carriers have experienced a *change* in conduct (coordinating behavior) in recent years

   - Employ:

     - demand data $\rightarrow$ demand for air travel

     - structural modeling $\rightarrow$ price competition w/ the possibility of internalizing pricing externalities

     - markup estimates from production data (to identify conduct)

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        - markup estimates from production data (to identify conduct)

3. Compare approaches to markup estimation
    - 1990-2019: production approach vs. demand approach under Nash-Bertrand competition

DATA

Data

1. **Production Data:** T-100 Domestic Segment and Air Carrier Financial Reports (Form 41 Financial Data)
   - Information on output (avialable seat miles), inputs, revenue, costs, network characteristics, etc.
   - Period 1990:Q1-2019:Q4
   - Carriers operating scheduled passenger service

2. **Demand Data:** DB1B 10% Fare Sample
   - Market level prices, quantities, and itinerary characteristics
   - Period 1993:Q2-2019:Q2
   - Markets between the 100 largest metropolitan areas (123 airports)
   - $\approx$ 75% of total air passengers traffic
   - Nonstop and 1-stop round-trip products

Markup Estimates

Production Approach to Markup Estimation

- Originates in the work of Hall (1988) and De Loecker and Warzynski (2012)

- Cost minimization conditions for any variable (flexible) input V_{it}^{x} provide:

$$\mu_{it} = \frac{P_{it}}{MC_{it}} = \theta_{it}^{V^x} \frac{P_{it} Q_{it}}{P_{it}^{V^x} V_{it}^{x}} \tag{1}$$

  - $\theta_{it}^{V^x} = \frac{\partial Q_{it}(.)}{\partial V_{it}^{x}} \frac{V_{it}^{x}}{Q_{it}}$ is the output elasticity of variable input V_{it}^{x}
  - $\frac{P_{it} Q_{it}}{P_{it}^{V^x} V_{it}^{x}}$ = share of variable input expenditure in total revenue (observed in data)

- $\theta_{it}^{V^x}$ needs to be estimated

Production in the Airline Industry

- Technology $s = \{M, R\}$ specific production function:

$$\begin{aligned} Q_{it} &= \min\left[\, H_{s,t}(l_{it}, k_{it}, g_{it}; \beta) e^{\omega_{it}}; \beta_{mit} M_{it} \,\right] e^{\epsilon_{it}} \\ &= H_{s,t}(l_{it}, k_{it}, g_{it}; \beta) e^{\omega_{it} + \epsilon_{it}} \end{aligned}$$

- where:
  - Q_{it} =output (available seat-miles)
  - m_{it}= logged jet fuel (1,000 gallons)
  - l_{it}= logged labor (number of employees)
  - k_{it}= logged aircraft utilization (minutes)
  - g_{it}= logged ground, property and equipment (stock value)
  - ω_{it} = productivity
  - ϵ_{it} = unexpected shock to output; $E_t(\epsilon_{it} \mid \mathcal{I}_{it}) = 0$

Production in the Airline Industry

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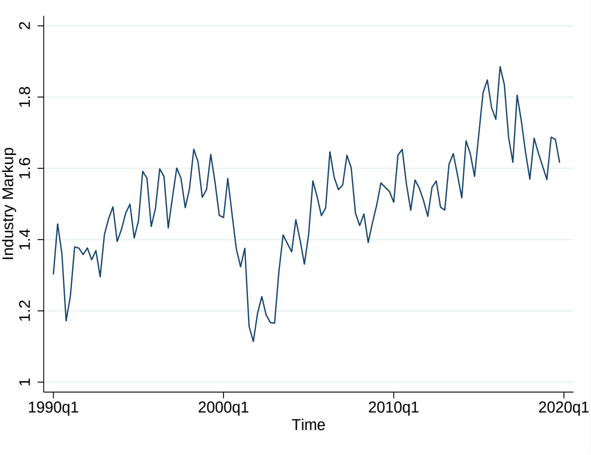
Production in the Airline Industry

- $H_{s,t}(.)$ assumed to be translog:
  - output elasticities w.r.t inputs are a function of input usage
  - include time controls to the production function
- Productivity evolves:

$$\omega_{it+1} = \rho\omega_{it} + \xi_{it+1}$$

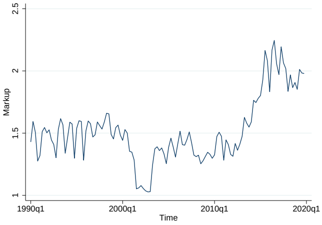
- Estimation by dynamic panel techniques (after ρ-differencing the model)

Industry Markup

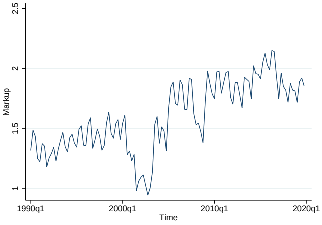


- Industry markup: $\mu_t^I = \sum_i s_{it} \mu_{it}$ with $s_{it} = q_{it} / \sum_i q_{it}$

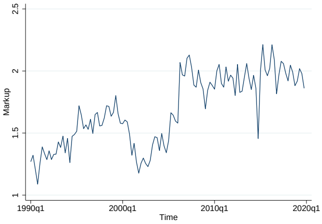
Markups: Dominant Airlines



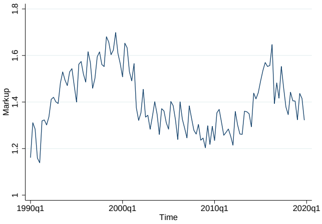
(a) American



(b) United



(c) Delta



(d) Southwest

Discussion

i. Trend is driven by dominant carriers

ii. Changes in industry markup are mostly driven by changes in the distribution of markups over time ◂ more

iii. Rise in markups is not explained by proportionally higher fixed costs or a larger scale elasticity ◂ more

iv. Rise in markups is explained by higher profit rates ◂ more

⇒ Findings point to an increase in market power

Robustness

- Robustness to alternative specifications:

  i. Production function estimation

     - Control function approach

  ii. Factor shares approach

  iii. Cost function estimation

Structural Analysis

Structural Analysis

- Goals:

  1. Test whether the recent increase in markups can be explained by a change in conduct (coordinating behavior)
     - Focus on 2012:Q2-2019:Q2
  2. Compare markups from production approach (imposes no assumptions on conduct) against markups from demand data + Bertrand-Nash competition
     - Focus on 1993:Q2-2019:Q2

Model Overview

- 2 essential components:

  1. Demand for Differentiated Products

  2. Supply: pricing equation

Demand

- Random coeff. nested logit model with two nests g: 0 (outside good) and 1 (airline travel)
    - Two consumer types, $\tau \in \{1, 2\}$ (i.e., business and leisure travelers)

- Two-step GMM estimation
    - Instruments for prices and shares: variables that affect costs and Gandhi and Houde (2019) differentiation instruments based on product characteristics and its interactions

Supply

- Max. problem for product j in market m at time t:

$$\max_{p_j : j \in \Omega_{amt}} \quad (p_{jmt} - mc_{jmt}) q_{jmt} + \sum_{k \neq j \in J_{mt}} O_{jkt} (p_{kmt} - mc_{kmt}) q_{kmt}$$

  - mc_{jmt}: marginal cost
  - $q_{jmt} = s_{jmt} \times M_{mt}$ represents the number of enplaned passengers
  - Ω_{amt}: set of product offerings of airline a in market m
  - J_{mt}: set of products in market m

- $O(\kappa)$ is an ownership matrix with:

$$O_{jkt} = \begin{cases} 1 & \text{if} \quad (j,k) \in \Omega_{amt} \quad \text{for any} \quad a \\ \kappa_{a,b,t} \in [0,1] & \text{if} \quad j \in \Omega_{amt} \quad \& \quad k \in \Omega_{bmt}, \quad \text{for any} \quad a \quad \& \quad a \neq b. \end{cases}$$

  - κ measures the degree of cooperation among firms when making their pricing decisions

Estimation Supply

- Equilibrium prices satisfy:

$$\hat{mc}_{mt}(\tilde{\kappa}, \hat{\theta}_d) = p_{mt} + \left[O_{mt}(\tilde{\kappa}) \odot \left(\frac{\partial s_{mt}(p_{mt}; \hat{\theta}_d)}{\partial p_{mt}} \right)^T \right]^{-1} s_{mt}(p_{mt})$$

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- Identification of κ relies on moment conditions:

$$E[\hat{\mathcal{M}}_{ajmt}] - (1 + \dot{\mu}_{at})\, E[\hat{\mathcal{M}}_{ajmt-1}] = 0$$

  - μ_{at}= markup estimate obtained under the production approach
  - $\hat{\mathcal{M}}_{ajmt} = p_{ajmt} / \hat{mc}_{ajmt}$
  - $\dot{x}$ denotes the growth rate of variable x

Conduct Parameter Estimates (κ)

	Small Carriers	Large Carriers
Year	**(1)**	**(2)**
2013	2.568e-05	0.253
	(0.007)	(0.002)
2014	2.647e-04	0.607
	(0.009)	(0.001)
2015	8.042e-06	0.740
	(0.010)	(0.001)
2016	1.214e-06	0.811
	(0.010)	(0.001)
2017	4.899e-07	0.762
	(0.005)	(0.001)
2018	2.077e-07	0.503
	(0.005)	(0.002)
2019	1.381e-07	0.481
	(0.004)	(0.002)

Note: This table reports the estimates of the conduct parameters κ. Columns (1) and (2) report, by year, the parameter estimates for small and large carriers, respectively. κ is set to zero in 2012. Standard errors are reported in parentheses.

Counterfactual Simulations:
Nash-Bertrand Pricing ($\kappa = 0$)

Variables	Avg. % Change
Consumer Surplus	16.141
	(13.490)
Prices (All Airlines)	-9.267
	(8.216)
Prices (American)	-10.907
	(6.752)
Prices (Delta)	-9.137
	(6.591)
Prices (United)	-10.509
	(6.858)
Prices (Southwest)	-10.487
	(7.703)

Conclusions

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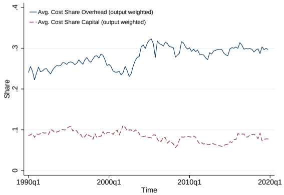
iv. 1990-2019: markups recovered under production approach significantly differ from markups obtained under demand data + Bertrand-Nash price competition

Thank you!

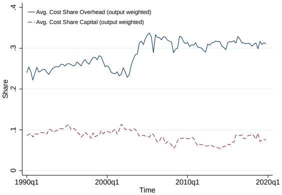
Discussion: Role of Reallocation

- Changes in industry markup are mostly driven by changes in the distribution of markups over time back

Discussion: Markups and Fixed Costs



(e) All



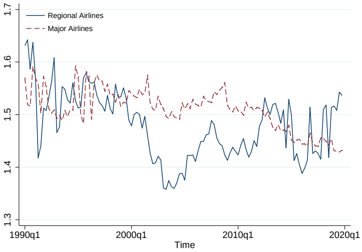
(f) Major

(g) Regional

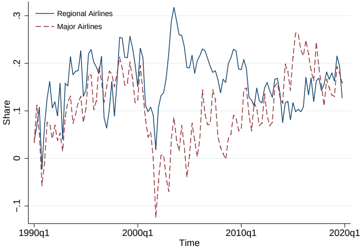
- Average (output-weighted) capital (red) and overhead (blue) cost shares back

Discussion: Markups, Profit Rate, and Scale Elasticity

- $\mu_{it} = \frac{1}{1-\pi_{it}} \nu_{it}$



(h) Avg. Scale Elasticity



(i) Avg. Profit Rate

- Average (output-weighted) profit rate (π_{it}) and scale elasticity (ν_{it}) for major (red) and regional (blue) airlines back

Supply

- To illustrate: market with 4 products
  - first two being offered by American Airlines
  - third and fourth offered by Delta and United, respectively

$$O(\kappa) = \begin{bmatrix} 1 & 1 & \kappa_{AA,DL} & \kappa_{AA,UA} \\ 1 & 1 & \kappa_{AA,DL} & \kappa_{AA,UA} \\ \kappa_{AA,DL} & \kappa_{AA,DL} & 1 & \kappa_{DL,UA} \\ \kappa_{AA,UA} & \kappa_{AA,UA} & \kappa_{DL,UA} & 1 \end{bmatrix}$$

- $\kappa_{AA,DL} = \kappa_{AA,UA} = 0$ under Nash-Bertrand pricing
- $\kappa_{AA,DL} = \kappa_{AA,UA} = 1$ under full cooperation