# Market Structure and Competition in Airline Markets

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# Motivation

Canonical workhorse models of demand and supply rely on the assumption that the set of products observed is "exogenous."

- Firms and products are not allocated to markets randomly.
- Firms strategically self-select themselves into markets based on observable and *unobservable* characteristics.

**Two potential problems:**

1. Biased estimates of demand elasticities (analogous to selection problem in labor literature).
    - Example:
        - Consider marginal entrant has (unobservably) high quality.
        - Entry might induce slightly lower prices because of increased competition, but demand goes up a lot.
        - Data: covariation between prices and quantities in this situation will make demand look too elastic.
2. What are effects of product entry/exit in a counterfactual setting?

# What is our contribution?

- Long tradition of IO economists thinking about *strategic* interactions.
- Firms play pricing game.
- Firms play and entry game.

Entry game $\implies$ multiple equilibrium $\implies$ no single probability that a particular firm enters the market.

# The Econometric Problem

- Consider the workhorse model of discrete choice demand for differentiated products.

- Consumer utility: $u_{ijt} = X_{jt}\beta - \alpha p_{jt} + \xi_{jt} + \epsilon_{ijt}$
  - product (j); market (t); consumer (i)
- Typically, estimation proceeds by making use of some a distributional assumption on unobserved product quality, $\{\xi\}$, to identify model:

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- Issue: Set of observed products set is not random.

- Consider firm entry decision: $y_{jt} = 1$ if enter and $y_{jt} = 0$ if not entered. If firms face a meaningful selection problem (non-zero fixed/sunk costs)

$$E[\xi|Z, y = 1] = 0 \;\not\Rightarrow\; E[\xi|Z] = 0$$

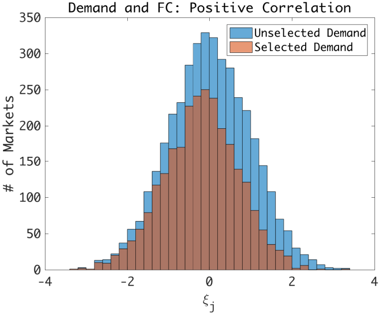
- More generally, entry and post-entry actions might be correlated – correlation between fixed costs and demand/mc unobservables.

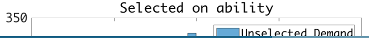
# Motivating Numerical Example

- 4 potential entrants, 1000 markets, simultaneous entry and pricing game.

- $\pi_j = (p_j - exp(\nu_j))s_j(p;\xi) - exp(-3 + \eta_j)$

- $(\xi_j, \nu_j, \eta_j) \sim N(0, \Sigma)$



# Literature: Estimating Entry and Competition

## Eizenberg (2014) – selection on observables

- Uses insights of Pakes, Porter, Ho, Ishii (2015) to estimate a model where PC manufacturers decide which computers to offer, then compete in prices.
- During the "entry" stage firms do not know $\xi$, only its distribution.
- This assumption may not always be appropriate:
  - Costs.
  - Mature industries.

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## Other Related Papers

- IO: Wollman (wp), Berry and Waldfogel [and Eizenberg] (1999,[2016]), Sweeting et al (wp)
- Trade: Roberts, Xu, Fan, Zhang (wp)
- Auctions: Gentry and Li (2014), Roberts and Sweeting (2013), Li and Zheng (2015)

# Literature: Product Repositioning

- Gandhi et al (2008) and Seim, Mazzeo, and Varela (wp) both use models and simulations to understand how prices are affected by product entry and repositioning after a merger.
- Li, Mazur, Sweeting and Roberts (wp) estimate similar model to ours, without mult. eq. and without correlations between unobservables – study connecting route repositioning.
- Fan (2012) [newpaper charactersitcs], Ashenfelter, Hosken, Weinberg (2015), Miller and Weinberg (wp) [collusion and efficiencies], etc. estimate other non-price outcomes of mergers.

# Findings

We estimate a model of competition and entry in airline markets using 2012 DB1B Department of Transportation airline data:

- Price-cost markups about 30% higher than a model with no selection.
- Correlation between unobservables is important for selection:
    - corr(Demand,FC)>0, corr(FC,MC)<0
    - Endogenous fixed costs improve production and demand.
- Simulate USAir-American merger:
    - Merger looks worse b/c of inelastic demand.
    - But post-merger entry mitigates price increases from merger.
    - Ambiguous effects come when merged firm replaces incumbent.
    - Merged firm faces stronger entry threat from legacy carriers, as opposed to low cost carriers.
        - During actual merger, DOJ focused on protecting LCCs market access.

# Plan of Talk

1. Methodological Example
    - Discuss estimation.
2. Model of Airline competition.
3. Data and Identification
4. Estimation Specifics and Results
5. AA - US Merger

# Methodological Example

# Simple Model with Two Firms

- Two firms simultaneously make a participation (entry) decision and, if active, realize some outcome (demand/profit/revenue).
- Complete information environment.
- Researcher has data on both the participation and the outcome.
- Outcome equation has endogenous variable (separate from entry decision).
- Researcher interested in primitives of participation and outcome equation.

# Simple Model: Entry with Two Firms

- The following system of equations describes the model:

$$\begin{cases} y_1 = 1\left[\delta_2 y_2 + \gamma Z_1 + \nu_1 \geq 0\right], \\ y_2 = 1\left[\delta_1 y_1 + \gamma Z_2 + \nu_2 \geq 0\right], \\ S_1 = y_1(X_1\beta + \alpha_1 P_1 + \xi_1), \\ S_2 = y_2(X_2\beta + \alpha_2 P_2 + \xi_2). \end{cases}$$

- $y_j = 1$ if firm $j$ decides to enter a market, and $y_j = 0$ otherwise.

- Consider Pure Strategy Nash solution.

- Endogenous variables: $(y_1, y_2, S_1, S_2, P_1, P_2)$. We observe $(S_1, P_1$ only if $y_1 = 1$ and $(S_2, P_2)$ if $y_2 = 1$.

- The variables $\mathbf{Z} \equiv (Z_1, Z_2)$ and $\mathbf{X} \equiv (X_1, X_2)$ are exogenous.

- Unobservables have a joint normal distribution,

$$(\nu_1, \nu_2, \xi_1, \xi_2) \sim N\left(0, \Sigma\right),$$

where $\Sigma$ is the variance-covariance matrix to be estimated.

# "Standard" Estimation Procedure

- Strategic interaction in the participation equation induced by $\delta_i y_i$.

$$\begin{cases} y_1 = 1\left[\delta_2 y_2 + \gamma Z_1 + \nu_1 \geq 0\right], \\ y_2 = 1\left[\delta_1 y_1 + \gamma Z_2 + \nu_2 \geq 0\right], \\ S_1 = y_1(X_1\beta + \alpha_1 P_1 + \xi_1), \\ S_2 = y_2(X_2\beta + \alpha_2 P_2 + \xi_2). \end{cases}$$

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- How would we estimate the parameters of the "outcome" equation?

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- Let's forget about that for a moment: $\delta_1 = \delta_2 = 0$.

- How would we estimate the parameters of the "outcome" equation?
  - Estimate a first stage probit.
  - Compute Inverse Mills Ratio.
  - Do IV with IMR for the outcome equation.

- Reiss and Spiller (1989) find positive correlation between demand/prices and entry.

# Challenges to Estimation

**Strategic nature of the entry decision is problematic.**

$$\begin{cases} y_1 = 1\left[\delta_2 y_2 + \gamma Z_1 + \nu_1 \geq 0\right], \\ y_2 = 1\left[\delta_1 y_1 + \gamma Z_2 + \nu_2 \geq 0\right], \\ S_1 = y_1(X_1\beta + \alpha_1 P_1 + \xi_1), \\ S_2 = y_2(X_2\beta + \alpha_2 P_2 + \xi_2). \end{cases}$$

1. A multi-agent version of the classic Heckman Selection problem.
   - Multiple equilibrium in the entry equation.
   - The selection region of the unobservables is a potentially complicated area that depends on the full equilibrium map.
   - The selection equation is incomplete – cannot use some well defined Inverse Mill Ratio.

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1. A multi-agent version of the classic Heckman Selection problem.
   - Multiple equilibrium in the entry equation.
   - The selection region of the unobservables is a potentially complicated area that depends on the full equilibrium map.
   - The selection equation is incomplete – cannot use some well defined Inverse Mill Ratio.
2. The “outcome” equation has an additional endogenous process.

# Our Solution

$$\begin{cases} y_1 = 1\left[\delta_2 y_2 + \gamma Z_1 + \nu_1 \geq 0\right], \\ y_2 = 1\left[\delta_1 y_1 + \gamma Z_2 + \nu_2 \geq 0\right], \\ S_1 = y_1(X_1\beta + \alpha_1 P_1 + \xi_1), \\ S_2 = y_2(X_2\beta + \alpha_2 P_2 + \xi_2). \end{cases}$$

- Directly simulate the equilibrium selection region of the unobservables.
  - Simulate all possible equilibria for many draws of the joint dist. of the errors.
  - Assume $(\xi_1, \nu_1) \sim N(0, \Sigma)$ where

$$\Sigma = \begin{pmatrix} \sigma_\xi & \sigma_{\xi,\nu} \\ \sigma_{\xi,\nu} & \sigma_\nu \end{pmatrix}$$

- Compare the **simulated selection region** of $\xi$ to the joint density of the residuals $(\hat{\xi})$ estimated from the data.

# Estimating the Distribution of the Unobservables

**Case where $(y_1 = 1, y_2 = 0)$:**

- For a given $(\alpha_1, \beta)$, the data identifies

$$Pr(S_1 - \alpha_1 P_1 - X_1\beta \leq t_1;\, y_1 = 1, y_2 = 0, X, Z)$$

  where $t_1$ arbitrary random variable independent of all variables in the model with the same support as $S_1$.

- CDF for residuals evaluated at $t_1$ and where we condition on *all exogenous variables* in the model.

# Model Implied Distribution of Unobservables with Multiple Equilibria

**We do not assume a eqm selection rule.**

$$\begin{cases} y_1 = 1\left[\delta_2 y_2 + \gamma Z_1 + \nu_1 \geq 0\right], \\ y_2 = 1\left[\delta_1 y_1 + \gamma Z_2 + \nu_2 \geq 0\right], \\ S_1 = y_1(X_1\beta + \alpha_1 P_1 + \xi_1), \\ S_2 = y_2(X_2\beta + \alpha_2 P_2 + \xi_2). \end{cases}$$

- $\left(\xi_1 \leq t_1;\, (\nu_1, \nu_2) \in A^U_{(1,0)}\right)$ be the set of $\xi_1$ that are less than $t_1$ when the unobservables $(\nu_1, \nu_2)$ belong to the set $A^U_{(1,0)}$.
    - $A^U_{(1,0)}$: set where $(1,0)$ unique Nash equilibrium outcome.
- $\left(\xi_1 \leq t_1;\, (\nu_1, \nu_2) \in A^M_{(1,0)}, d_{(1,0)} = 1\right)$ be the set of $\xi_1$ less than $t_1$ when unobservables $(\nu_1, \nu_2)$ belong to set $A^M_{(1,0)}$.
    - $A^M_{(1,0)}$: set where $(1,0)$ one among multiple equilibria outcomes.
    - $d_{(1,0)} = 1$ indicate that $(1,0)$ was selected.

# Recap

- We find the distribution of residuals for the outcome equation implied by the **data**:

$$Pr(S_1 - \alpha_1 P_1 - X_1\beta \leq t_1;\, y_1 = 1, y_2 = 0, X, Z).$$

- For the same parameters, we simulate the model and derive the distribution of unobservables, accounting for multiple equilibria:

$$Pr\left(\xi_1 \leq t_1;\, (\nu_1, \nu_2) \in A^U_{(1,0)}\right)$$
$$Pr\left(\xi_1 \leq t_1;\, (\nu_1, \nu_2) \in A^M_{(1,0)}, d_{(1,0)} = 1\right)$$

# Bounds of the Distribution of Residuals

- "Match" distribution of residuals (at a given parameter value) from data with its counterpart predicted by the selection model.

- By the law of total probability:

$$
\begin{aligned}
Pr(\xi_1 \leq t_1; y_1 = 1, y_2 = 0, \mathbf{X}, \mathbf{Z}) \quad &= \quad Pr\left(\xi_1 \leq t_1; (\nu_1, \nu_2) \in A^U_{(1,0)}, \mathbf{X}, \mathbf{Z}\right) \\
&+ \quad Pr(d_{(1,0)} = 1 \mid \xi_1 \leq t_1; (\nu_1, \nu_2) \in A^M_{(1,0)}, \mathbf{X}, \mathbf{Z}) \\
&\quad\quad Pr\left(\xi_1 \leq t_1; (\nu_1, \nu_2) \in A^M_{(1,0)}, \mathbf{X}, \mathbf{Z}\right)
\end{aligned}
$$

- $Pr(d_{1,0} = 1 \mid \xi_1 \leq t_1; (\nu_1, \nu_2) \in A^M_{(1,0)})$ unknown and represents the equilibrium selection function.

- Conduct inference using natural upper and lower bounds on this unknown function:

$$
\begin{aligned}
& Pr\left(\xi_1 \leq t_1; (\nu_1, \nu_2) \in A^U_{(1,0)}\right) \\
\leq \quad & Pr(S_1 - \alpha_1 P_1 - X_1 \beta \leq t_1; y_1 = 1, y_2 = 0) \\
\leq \quad & Pr\left(\xi_1 \leq t_1; (\nu_1, \nu_2) \in A^U_{(1,0)}\right) + Pr\left(\xi_1 \leq t_1; (\nu_1, \nu_2) \in A^M_{(1,0)}\right)
\end{aligned}
$$

# Moment Inequality Condition

- The middle part can be consistently estimated from the data given a value for $(\alpha_1, \beta, t_1)$:

$$Pr(S_1 - \alpha_1 P_1 - X_1\beta \leq t_1;\, y_1 = 1; y_2 = 0)$$

- We simulate the upper and lower bound on the distribution of unobservables implied by the selection model for a given value of the parameter vector:

$$Pr\left(\xi_1 \leq t_1;\, (\nu_1, \nu_2) \in A^U_{(1,0)}\right),\ Pr\left(\xi_1 \leq t_1; (\nu_1, \nu_2) \in A^M_{(1,0)}\right)$$

- Conditional moment inequality model where at the truth, the moment inequalities above hold for all $\mathbf{X}, \mathbf{Z}, t_1$.

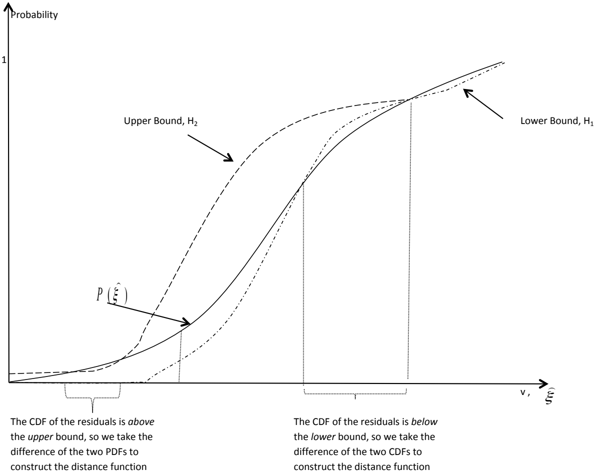
- Use standard moment inequality methods to conduct set inference.

$$E[\mathbf{G}(\theta, S_1y_1, S_2y_2, P_1y_1, P_2y_2, y_1, y_2; t_1, t_2)|\mathbf{Z}, X] \leq 0$$

# Estimation – Moment Conditions

- Construct moments using the following inequality:

$$Pr^L(\xi^* < t \mid ...) \leq Pr(\hat{\xi} < t \mid ...) \leq Pr^U(\xi^* < t \mid ...)$$



# A Model of Airline Entry and Pricing

# Model: Demand and Supply

- Market ($m$) is a unidirectional airport pair with $k$ potential entrants.
- Firms simultaneously decide entry and prices.

**Demand**

- Nested Logit, inside/outside nesting structure:

$$\begin{aligned} u_{ijm} &= X_{jm}\beta + \alpha p_{jm} + \xi_{jm} + v_{igm} + (1-\sigma)\epsilon_{ijm} \\ \implies ln(s_{jt}) - ln(s_{j0}) &= X_{jm}\beta + \alpha p_{jm} + \sigma ln(s_{j|g}) + \xi_{jm} \end{aligned} \tag{1}$$

**Supply**

- Simultaneous Nash Bertrand pricing with constant marginal cost (Berry, 1994):

$$log(mc_{jm}) = log(p + \frac{1-\sigma}{\alpha(1-\sigma\bar{s}_{j|g} - (1-\sigma)s_j)}) = \phi W_{jm} + \eta_{jm} \tag{2}$$

# Model: Entry

- **Entry** equation:

$$y_{jm} = 1 \iff \underbrace{(p_{jm} - mc_{jm})M_m s_{jm}}_{Var.Profits} - \underbrace{exp(\gamma Z_{jm} + \nu_{jm})}_{FixedCosts} \geq 0 \qquad (3)$$

- $3 \times J$ equations plus selection rule describes the equilibria.

- **Structural Errors**:

- Demand, MC, FC Errors, $(\xi_{jm}, \eta_{jm}, \nu_{jm})$ are joint normal with mean zero and covariance:

$$\Sigma_{1m} = \begin{pmatrix} \sigma_\xi^2 & \sigma_{\xi\eta} & \sigma_{\xi\nu} \\ \sigma_{\xi\eta} & \sigma_\eta^2 & \sigma_{\nu\eta} \\ \sigma_{\xi\nu} & \sigma_{\nu\eta} & \sigma_\nu^2 \end{pmatrix} \qquad (4)$$

# How is this different than the simple model?

1. Added nonlinearities.
2. Need to *solve for the equilibrium of the full model*, which has six (rather than just four) endogenous variables (**prices!**).
3. There are *three* unobservables for each firm over which to integrate (marginal cost, demand, fixed cost).

# A look back at the literature

- If we were to estimate the demand and supply conditions, then we have Berry 94, BLP etc.
  - Set of products/airline taken as exogenous.
  - Cannot estimate features of fixed costs distribution.
- If we were to estimate a reduced form version of the entry conditions, we have Bresnahan and Reiss (many), Berry 92, etc.
  - Difficult to make inferences on primitives like market power, welfare, etc.
- For sure, traction has been made on estimating these "jointly":
  - Berry/Waldgoel (1999) Berry/Waldfogel/Eizenberg (wp)
  - Eizenberg (2014)
- Our solution allows for meaningful selection on unobservables, in the sense of Heckman 76/79.

# Empirical Setting

- Domestic commercial airline industry:
  - Considerable price differences across markets and market structure.
  - Considerable variation in market structure, with many recent mergers.
- Unit of observation: airline-market from DOT's DB1B and T-100 datasets in 2012.
- Market: unidirectional trip between two airports (6,322 markets, including 172 not served by any airline).
- Six airlines: American (AA), Delta (DL), United (UN), US Air (US), Southwest (WN), and a composite Other Low Cost Carrier (LCC)
- Number of potential entrants varies across markets, based on existing flights at endpoints.

# Descriptive Statistics – Entry

Table: Percent of Markets Served

| | Entry | Potential |
|---|---|---|
| AA | 0.48 | 0.90 |
| DL | 0.83 | 0.99 |
| LCC | 0.26 | 0.78 |
| UA | 0.66 | 0.99 |
| US | 0.64 | 0.95 |
| WN | 0.35 | 0.38 |

Table: Distribution of Number of Entrants

| | Number of Entrants | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Fraction of markets | 0.08 | 1.11 | 5.16 | 18.11 | 42.87 | 32.68 |

# Endogenous Variables

- Entry: $y_{jm}$
- Prices: $p_{jm}$
- Shares/Demand: $s_{jm}$
- $p_{jm}$ and $s_{jm}$ are only observed if $y_{jm} = 1$

# Exogenous Variables – Demand

- *Nonstop Origin*: number of non-stop routes that an airline serves out of the origin airport.
    - Proxy of frequent flyer programs: the larger the share of nonstop markets that an airline serves out of an airport, the easier is for a traveler to accumulate points, and the more attractive flying on that airline is.
- *Distance* between the origin and destination airports is also a determinant of demand.

# Exogenous Variables – Flight/Pass. Costs (MC)

- *Origin Presence*: the *ratio* of markets served by an airline out of an airport over the total number of markets served out of that airport by at least one carrier.

- We think of this as the opportunity cost for not using a particular plane (seats/personnel/etc) for another flight. The more opportunities there are to use a particular plane, the higher the opportunity costs.

# Exogenous Variables – Airport Costs (FC)

- Airport/fixed costs do not change with an additional passenger flown on an aircraft, or the use of the that plane for some other reason at that airport.
- Airlines must lease gates and hire personnel to enplane and deplane aircrafts at the two endpoints.
- *Nonstop Origin*: # of nonstop routes from origin.
- *Nonstop Destination*: the number of non-stop routes that an airline serves out of the destination airport.

# Descriptive Statistics

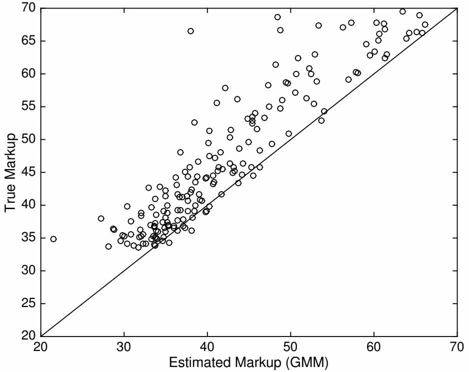
Table: *Summary Statistics*

| | Mean | Std. Dev. | Min | Max | N | Equation |
|---|---|---|---|---|---|---|
| Price ($) | 243.21 | 54.20 | 139.5 | 385.5 | 20,470 | Entry, Utility, MC |
| **All Markets** | | | | | | |
| Origin Presence (%) | 0.44 | 0.27 | 0 | 1 | 37,932 | MC |
| Nonstop Origin | 6.42 | 12.37 | 0 | 127 | 37,932 | Entry, Utility |
| Nonstop Dest. | 6.57 | 12.71 | 0 | 127 | 37,932 | Entry |
| Distance (000) | 1.11 | 0.63 | 0.15 | 2.72 | 37,932 | Utility, MC |
| **Markets Served** | | | | | | |
| Origin Presence (%) | 0.58 | 0.19 | 0.00 | 1 | 20.470 | MC |
| Nonstop Origin | 8.50 | 14.75 | 1 | 127 | 20.470 | Entry, Utility |
| Nonstop Destin. | 8.53 | 14.70 | 1 | 127 | 20.470 | Entry |
| Distance (000) | 1.21 | 0.62 | 0.15 | 2.72 | 20,472 | Utility, MC |

# Estimation and Results

# Numerical Exercise: Evidence of Selection

- We claimed that there is a selection problem in demand/supply estimation.
- Generate data using model with different sets of parameters.
- We estimate market power using standard GMM framework of Berry (1994).
- In all cases, $corr(\xi, \nu) > 0$.



# Estimation Algorithm

- Guess parameters $(\beta^0, \alpha^0, \sigma^0, \phi^0, \gamma^0, \Sigma^0)$.
- Using $\Sigma^0$, draw from the unselected distribution of errors.
- Solve all equilibria of of the model and construct an upper and lower envelope for the cdf of selection region.

$$\{Pr^L(\{\xi*, \eta*\} < \boldsymbol{t}|\boldsymbol{\Omega}), Pr^U(\{\xi*, \eta*\} < \boldsymbol{t}|\boldsymbol{\Omega})\},\ \Omega = (X, W, Z, y) \tag{5}$$

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- Also, construct the data identified distribution of "selected" residuals

$$\begin{aligned} Pr(ln(s_{jt}) - ln(s_{j0}) - (X_{jm}\beta^0 + \alpha^0 p_{jm} + \sigma^0 ln(s_{j|g})) < t|\boldsymbol{\Omega}, \boldsymbol{y}) \\ = Pr(\hat{\xi}_{jm} < t|\boldsymbol{\Omega}, \boldsymbol{y}) \quad (6) \end{aligned}$$

- In practice, construct moments from matching bin counts of the cdfs, conditional on a market type.
- Use sub-sampling routine suggested by CHT for inference.

# Computational Challenges

- Solve for all possible equilibria
  - Typical type of mult eq in entry games.
  - Assume a unique pricing equilibrium given a market structure (nested logit).
- Probably a very funny looking objective function, so simulation bias could be a serious issue.
- Both issues imply non-trivial computational costs.

# Parameter Estimates

Table: *Parameter Estimates: Exogenous vs Endogenous Market Structure*

| | Exog Mkt Structure | Endog Mkt Structure |
|---|---|---|
| **Demand** | Point Est. (s.e.) | Conf. Inter. |
| Constant | -2.863 (0.225) | [-5.499, -5.467] |
| Distance | 0.319 (0.015) | [ 0.184, 0.191] |
| Nonstop Origin | 0.180 (0.008) | [ 0.125, 0.130] |
| LCC | -0.980 (0.053) | [-0.345, -0.333] |
| WN | 0.416 (0.038) | [ 0.222, 0.230] |
| Price($\alpha$) | -0.025 (0.001) | [-0.012, -0.011] |
| $\sigma$ | 0.080 (0.017) | [ 0.481, 0.499] |
| **Marginal Cost** | | |
| Constant | 5.338 (0.003) | [ 5.173, 5.221] |
| Distance | 0.064 (0.002) | [ 0.030, 0.031] |
| Origin Presence | -0.041 (0.003) | [-0.242, -0.233] |
| LCC | -0.127 (0.007) | [-0.132, -0.127] |
| WN | -0.282 (0.008) | [-0.088, -0.085] |
| **Fixed Cost** | | |
| Constant | – | [ 7.768, 8.066] |
| Nonstop Origin | – | [-0.142, -0.137] |
| Nonstop Dest. | – | [-0.333, -0.321] |
| LCC | – | [-0.003, -0.003] |
| WN | – | [-1.642, -1.583] |
| Demand-FC Correlation | – | [ 0.721, 0.758] |
| Demand-MC Correlation | 0.683 | [ 0.382, 0.396] |
| MC-FC Correlation | – | [-0.299, -0.288] |
| Median Elas. of Demand | -5.567 | [-2.43,-2.40] |
| Median Markup | 38.167 | [51.25,53.40] |

# Takeaways from Estimation Results

- Selection model price elasticity is half the size of exogenous model.
- Story: Firms who enter are "better" (demand/mc unobservables) and therefore can exert more market power.
- Airline heterogeneity important in both demand and costs.
- Correlation in unobservables implies selection is important.

# Merger with Endogenous Repositioning

# Merger Simulation

- Simulate merger between American and USAir (our data is pre-merger).
- Consider a "best case" scenario for the new AA/US merged firm.
- Details:
  - Eliminate US as a potential firm.
  - In each market, assign AA the "best" observable and unobservable characteristics between the pre-merged AA and US.
  - Implies AA will have weakly lower costs and weakly higher utility after the merger.

# Economics of Merger with Endogenous Entry

Increased Concentration (markets with US and AA pre-merger)

- Less competition $\implies$ higher prices [EX].
- New firm enters market – ?? prices.

AA/US lower marginal costs:

- Lower prices. [EX]
- Rivals might exit b/c fiercer price competition.
- AA/US might enter new markets.

AA/US lower fixed costs:

- Entry into new markets, could replace incumbents or drive down prices.

AA/US higher consumer utility:

- AA/US can raise price.[EX]
- AA/US enters new markets because charge higher prices and cover FC.
- AA/US steal consumers from rivals – rivals exit.

# Post Merger Entry/Exit in Concentrated Markets

- AA enters unserved markets. Also, high likelihood of monopolization.

Table: Market Structures in AA and US Monopoly and Duopoly Markets

| | Post-merger | |
|---|---|---|
| Pre-merger | No Firms | AA Monopoly |
| No Firms | [0.36,0.90] | [0.10,0.19] |
| AA & US Duopoly | [0.00,0.01] | [0.20,0.82] |

# Post Merger Entry/Exit in Concentrated Markets

- Many markets that DL is potential entrant. Now enters as duopoly.

Table: Entry of Competitors in AA and US Duopoly Markets

| | Post-merger market structure | | | |
|---|---|---|---|---|
| Pre-merger | Duopoly AA/US & DL | Duopoly AA/US & LCC | Duopoly AA/US & UA | Duopoly AA/US & WN |
| Duopoly AA & US | [0.08,0.25] | [0.01,0.02] | [0.05,0.11] | [0.00,0.01] |

Table: AA/US Price Changes in Duopoly Markets

| | Post-merger market structure | | | |
|---|---|---|---|---|
| Change in the price of AA | Duopoly AA/US & DL | Duopoly AA/US & LCC | Duopoly AA/US & UA | Duopoly AA/US & WN |
| Duopoly AA & US | [-0.12,-0.01] | [-0.01,0.03] | [-0.06,0.00] | [0.00,0.04] |

# Markets Involving DCA

- DCA was an airport with a high presence by AA and US.
- Type of market that is particularly concerning for regulators.
- The DOJ approved the merger conditional on AA giving up slots to other competitors.

Table: Post-merger entry and pricing in pre-merger AA & US Duopoly markets, Reagan National Airport

| Prob mkt structure | Monopoly AA/US | Duopoly AA/US & DL | Duopoly AA/US & LCC | Duopoly AA/US & UA | Duopoly AA/US & WN |
|---|---|---|---|---|---|
| Mkt Struct. Transitions | [0.161, 0.710] | [ 0.136, 0.227] | [0.000, 0.047] | [0.059, 0.188] | [0.000, 0.000] |
| % Change in Prices | [0.019, 0.089] | [-0.095, 0.018] | [-0.073, 0.126] | [-0.114, 0.068] | [n.a.] |

# Market Structure and Price Transitions

Table: Post-merger Entry of AA in New Markets

| | (1) | (2) | | (3) | | (4) | | (5) |
|---|---|---|---|---|---|---|---|---|
| Monopoly | | | Duopoly | | 3-opoly | | 4-opoly | |
| Pre-merger Firms | AA Replacement | AA Entry | Pre-merger Firms | AA Entry | Pre-merger Firms | AA Entry | Pre-merger Firms | AA Entry |
| DL | [0.02,0.09] | [0.19,0.25] | DL,LCC | [0.09,0.27] | DL,LCC,UA | [0.21,0.35] | DL,LCC,UA,WN | [0.27,0.44] |
| LCC | [0.07,0.19] | [0.02,0.14] | DL,UA | [0.24,0.32] | DL,LCC,WN | [0.10,0.33] | | |
| UA | [0.04,0.12] | [0.10,0.21] | DL,WN | [0.16,0.27] | DL,UA,WN | [0.29,0.37] | | |
| WN | [0.01,0.04] | [0.10,0.19] | LCC,UA | [0.05,0.22] | LCC,UA,WN | [0.07,0.29] | | |
| | | | LCC,WN | [0.04,0.23] | | | | |
| | | | UA,WN | [0.11,0.26] | | | | |

# Market Structure and Price Transitions

Table: Post-Merger Price Changes After the Entry of AA in New Markets

| Monopoly | | Duopoly | | 3-opoly | | 4-opoly | |
|---|---|---|---|---|---|---|---|
| Pre-merger Firms | %ΔPrice | Pre-merger Firms | %ΔPrice | Pre-merger Firms | %ΔPrice | Pre-merger Firms | %ΔPrice |
| DL | [-0.12,-0.08] | DL | [-0.05,-0.03] | DL | [-0.03, -0.01] | DL | [-0.02, -0.01] |
| | | LCC | [-0.01,-0.01] | LCC | [-0.01,-0.00] | LCC | [-0.00,-0.00] |
| | | | | UA | [-0.015 -0.010] | UA | [-0.01,-0.01] |
| | | | | | | WN | [-0.01,-0.00] |
| LCC | [-0.10,-0.09] | DL | [-0.04,-0.02] | DL | [-0.028,-0.014] | | |
| | | UA | [-0.02,-0.02] | LCC | [-0.008,-0.004] | | |
| | | | | WN | [-0.012,-0.008] | | |
| UA | [-0.12,-0.09] | DL | [-0.05,-0.03] | DL | [-0.021,-0.013] | | |
| | | WN | [-0.02,-0.01] | UA | [-0.016,-0.010] | | |
| | | | | WN | [-0.008,-0.006] | | |
| WN | [-0.11,-0.08] | LCC | [-0.02,-0.01] | LCC | [-0.011,-0.005] | | |
| | | UA | [-0.04,-0.03] | UA | [-0.025,-0.015] | | |
| | | | | WN | [-0.009,0.001] | | |
| | | LCC | [-0.04,-0.02] | | | | |
| | | WN | [-0.05,-0.02] | | | | |
| | | UA | [-0.04,-0.03] | | | | |
| | | WN | [-0.02,-0.02] | | | | |

# Conclusions

- Estimate a model of supply/demand with endogenous entry.
- Market power estimates differ substantially from exogenous market structure estimates.
- Potential upside of merger due to entry.
- Many possible changes to market structure and prices.

# Transitions with Exit

Table: Likelihood of Exit by Competitors after AA-US Merger

| Duopoly with AA | | 3-opoly with AA | |
|---|---|---|---|
| Pre-merger Firm | Exit | Pre-merger Firms | Exit |
| DL | [0.03,0.05] | DL | [0.05,0.15] |
| | | LCC | [0.01,0.01] |
| LCC | [0.09,0.16] | DL | [0.04,0.14] |
| | | UA | [0.01,0.05] |
| UA | [0.06,0.08] | DL | |
| | | WN | |

Table: Price Changes From Exit of Competitor After Merger

| Duopoly | | 3-opoly | | | |
|---|---|---|---|---|---|
| Pre-merger Firm | AA %ΔPrice | Pre-merger Firm | %ΔPrice | Pre-merger Firm | %ΔPrice |
| DL | [-0.02,0.04] | AA | [-0.07,-0.05] | DL | [-0.03,-0.00] |
| | | AA | [-0.01,0.06] | LCC | [-0.02,0.01] |
| LCC | [0.01,0.07] | AA | [-0.07,-0.04] | DL | [-0.03,0.03] |
| | | AA | [-0.02,-0.00] | UA | [-0.03,0.02] |
| UA | [0.01,0.08] | AA | [-0.05,-0.02] | DL | [-0.01,0.01] |
| | | AA | [-0.04,-0.01] | WN | [-0.02,0.03] |