Discussion of “Dynamic Price Competition: Theory and Evidence from Airline Markets”

by Hortaçsu, Öry and Williams

Juan Ortner

Summary

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- Study dynamic pricing under oligopoly, in settings with restricted capacity and sale deadlines

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Main results

- <u>Theory</u>: duopoly quite different from monopoly!
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Main results

- Theory: duopoly quite different from monopoly!
- Pricing depends on own scarcity and competitor's scarcity
  $\rightarrow$ prices may be strategic complements or substitutes
- Empirics: estimate model using comprehensive data
- Uniform pricing leads to higher CS and welfare than dynamic pricing;
  pricing heuristics also lead to higher CS and welfare

Model

- n firms sell products $\mathcal{J} = \{1, ..., J\}$
  products are imperfect substitutes, must be sold by date T
- At each $t = 0, \Delta, ..., T - \Delta, T$, each firm f chooses prices $(p_{f,j})_{j \in \mathcal{J}_f}$, where $\mathcal{J}_f \subset \mathcal{J}$ are the products that f sells
- At each t, a single consumer arrives with prob $\Delta\lambda_t > 0$;
  given $\mathbf{p} = (p_j)_{j \in \mathcal{J}}$, purchases good j with prob $s_j(\mathbf{p}; \theta_t, \mathcal{A}_t)$
- Initial capacities $\mathbf{K}_0 = (K_{0,j})_{j \in \mathcal{J}}$;
  capacities publicly observed, reduced with each sale

Monopoly

- Suppose there is a single firm
- Monopolist sets prices

  $$\mathbf{p}^M = \arg\max_{\mathbf{p}} \sum_j s_j(\mathbf{p})(p_j - \omega_{j,t}(\mathbf{K})),$$

  where

  $$\omega_{j,t}(\mathbf{K}) = \Pi_{M,t+\Delta}(\mathbf{K}) - \Pi_{M,t+\Delta}(\mathbf{K} - \mathbf{e}_j)$$

  is change in continuation profits if K_j falls by one unit
- As $\Delta \to 0$, firm profits converge; limiting profits solve a well-behaved ODE

Duopoly

- Suppose now there are two firms, two products, each firm controls one
- Firm f now sets price p_f:

  $$p_f = \arg\max_{p_f} s_f(p_f, p_{-f})(p_f - \omega^f_{f,t}(\mathbf{K})) - s_{-f}(p_f, p_{-f})\omega^f_{-f,t}(\mathbf{K}),$$

  where $\omega^f_{\tilde{f},t}(\mathbf{K})$ is change in f's continuation profits if $K_{\tilde{f}}$ falls by one unit
- Firm f now evaluates the effect it's price has on the chances $-f$ makes a sale;
  prices may be substitutes or complements; there can be multiple equilibria
- Under certain conditions, profits also converge as $\Delta \to 0$; limiting profits also solve an ODE

Empirical Analysis

- Comprehensive booking data: prices, routes, bookings,....
- Focus on routes in which only two firms compete (58 routes)
- Estimate consumers' arrival process, and their demand $\rightarrow$ recover equilibrium prices

Counterfactuals

- Compare equilibrium outcomes with outcomes under: (i) uniform pricing; (ii) pricing heuristics
- Uniform pricing leads to higher CS and welfare than dynamic pricing, and to lower revenue
  consumers who arrive later, and who have high valuation, get the good at a lower price
- Pricing heuristics also lead to higher CS and welfare than dynamic pricing

Comment I: Other Pricing Heuristics?

- Pricing dynamics under duopoly are complicated;
  $\rightarrow$ firms consider own and competitor's scarcity effects
- In practice, airlines likely use simpler pricing rules;
  this motivates the "pricing heuristics" counterfactuals

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- An alternative pricing rule: firms set prices optimally, assuming competitors' capacities evolve exogenously:

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- Equilibrium dynamics under such pricing rule?
- Which pricing rule explains data better? benchmark? heuristics? this other rule?

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  all between small cities? are there large city $\leftrightarrow$ small city routes? how many are on weekdays, weekends?

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- How similar/different are the routes in the data?
  all between small cities? are there large city $\leftrightarrow$ small city routes? how many are on weekdays, weekends?
- Estimate model separately for different types of routes (e.g., weekday flights vs. weekend flights; small cities vs. large cities)?

Comment III: Dynamic vs. Uniform Pricing

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- In contrast to previous studies, uniform pricing leads to higher CS and welfare than dynamic pricing
- But uniform pricing also leads to lower firm revenue
- A switch to uniform pricing may have other welfare-reducing effects: less frequency of flights, worse service, worse times...

Comment IV: Frequent Flyers?

- Pricing dynamics likely different when buyers face switching costs
- Does dataset contain information on buyers' membership to loyalty programs? share of frequent flyers? share that switches between airlines?
- Can model and estimation be modified to account for frequent flyers? (e.g., different types of buyers, depending on their loyalty status)