The invisible costs of promoting competition in the airlines industry

Hoang Dao, PhD Candidate
University at Buffalo, Economics Department

Abstract

Since the Airline Deregulation Act in 1978, the airline industry drastically transitioned from the most condensed and regulated industry to one of the most competitive one. From 1990 to 2018, annual passenger enplanement doubled to almost 900 million customers while average inflation-adjusted fare halved to $350. Airline industry's profit margin is among the lowest at 8.2% in 2018, only slightly more than half of that of U.S. average (15.2%). How would such competition affect airline's behavior, market structure, and ultimately, the future of aviation? This paper explores the effects of airline industry competition on the firms' costs and operations behavior. Specifically, the effects of competition on airline's safety expense, product-differentiation expense, route choices and fleets.

Introduction

This article begins by deriving an estimate for the degree of competition, employing the discrete choice techniques with differentiated product to estimate the demand for air travel in the U.S. domestic markets. A measure for competition in the industry is formulated for each airline during the period. This competition index is then used to evaluate the effect of competition on the multiple costs and characteristics of airlines, using the instrumented difference in differences method. My result shows that, the expense for safety does not change significantly, but the expenses for product differentiation decreases as the markets become more competitive. Airlines fly longer routes on average, and air fleets gravitates towards homogeneously narrow-body, long-distance airplanes as airlines face more competition.

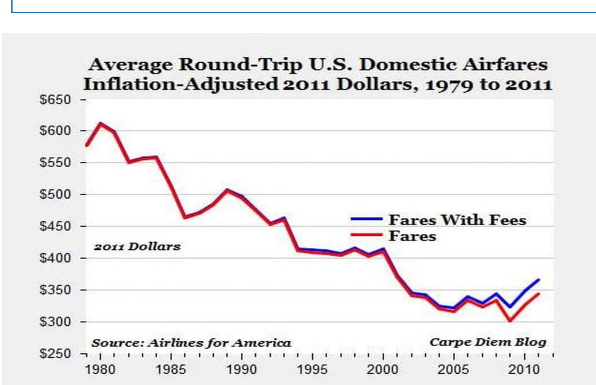

Figure 1. Airfare trend 1979-2011

	Fleet Operated	Seats Per Departure	Stage Length	Daily Hours Utilization	Departures Per Day
Small Narrow-bodies	567	143	702	10.9 hrs.	5.6
Large Narrow-bodies	158	175	1,073	11.4 hrs.	4.2
Total Fleet	725	151	766	11.0 hrs.	5.3

Figure 2. Budget airline fleet homogeneity and usage, example.

Data

1. For demand estimation: Data Bank 1B (DB1B) from 1993Q1 to 2018Q4: 10% of US domestic itineraries
   Variables: itinerary, airlines, fare ticket, distance, nonstop status,
2. Financial information: form 41 Schedule P1-2, P-7,B4-3
   Variables: airlines' expenses, fleet details

Demand estimation

The demand estimation model in this paper is mainly following Berry-Lehvinson-Pakes (1995) and Nevo (2001). The reason for this model choice is to address the endogeneity in pricing behavior, as well as to generate a realistic substitution pattern between carriers within each year-quarter.
The utility is written as:

$$U_{ijm} = \underbrace{[x_{jm}\beta_2 - \beta_1 P_{jm} + \xi_{jm}]}_{\mu_{jm}} + \underbrace{[[-P_{jm}, x_{jm}](\Omega O_i + \Theta\theta_i)]}_{\delta_{ijm}} + \varepsilon_{ijm}$$

With an estimation of the following logistic function

$$Q_{jm} = \frac{e^{\mu_{jm}+\delta_{ijm}}}{\sum_{k=0}^{J} e^{\mu_{km}+\delta_{ikm}}}$$

Specifically, I estimate the following GMM optimization:

$$\beta^* = \underset{\beta^*}{argmin} \xi' Z \Phi^{-1} Z' \xi \qquad (17)$$

Where

- $\Phi$is an estimation of $E[Z'\xi\xi'Z]$, the weighting matrix of the GMM calculation.
- $\xi = \mu_{jm} - (-\beta_1 P_{jm} + \beta_2 x_{jm})$
- And $\beta^* = (\beta_1, \beta_2, \Omega, \Theta)$

In the end, what I aim at is to estimate the own-price elasticity using the formula:

$$\zeta_{jm} = \frac{\partial Q_{jm}/\partial P_{jm}}{Q_{jm}/P_{jm}} = \frac{-P_{jm}}{Q_{jm}} \int \beta_{1i} Q_{ijm} - \beta_{1i} Q_{ijm}^2 dF_O(O) dF_\theta(\theta)$$

Contact

Hoang Dao
University at Buffalo, State University of New York
Email: hoangxua@buffalo.edu
Website: linkedin.com/hoang-dao
Phone: 716-400-2787

Results for demand estimation

We can see the trend for the own-price elasticity for industry average and also select carriers in the US in the period from the first quarter of 1993 to the end of 2018. The figures suggest an increasingly elastic market for the industry: the absolute value of own-price elasticity is significantly higher than 1993 for every one of the graphs. The whole market uniformly face with an increasingly competitive market. This variations in average industry elasticity is used in the next section to examine the effects of such increased competition on the cost behavior of airlines.

The heterogeneity captured through income, age and gender. From the results, wealthier passengers care less about prices and more about product characteristics, especially about whether the flight is nonstop. This is intuitive since we expect higher income individuals to have higher opportunity costs of time. Higher income and older individuals also care more about comfort (whether the airline is budget). Females have strong distaste towards both higher prices and discomfort.

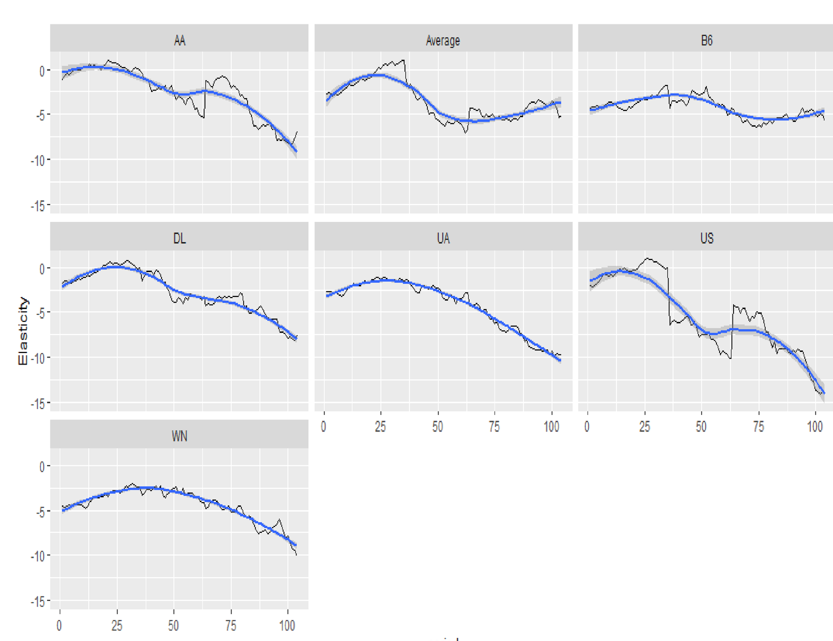

Figure 3 Own-price elasticity result: it's becoming more competitive.

	All year-quater		1993Q1		2018Q4	
	Mean	Stdv	Mean	Stdv	Mean	Stdv
Constant	71.45***	30.12***	72.12***	27.98***	82.92***	29.19***
	(1.26)	(6.37)	(20.29)	(8.43)	(13.75)	(11.12)
Price	-44.05***	2.86	-20.24***	1.72	-79.75***	6.12***
	(3.08)	(2.45)	(2.43)	(1.98)	(4.16)	(0.87)
Nonstop=0	-4.17***	1.17	0.04	0.02	-7.88***	3.98***
	(0.15)	(2.12)	(0.11)	(1.64)	(0.04)	(1.82)
Major at origin	8.14***	3.11***	13.11***	5.44	6.09**	3.12*
	(1.03)	(1.10)	(1.71)	(4.32)	(2.97)	(2.45)
Budget=1	-9.72***	1.45***	-15.44***	3.23***	-18.45	1.04*
	(2.11)	(0.42)	(1.20)	(0.67)	(1.99)	(0.66)
Income * Price	31.69***		17.42***		23.42***	
	(5.76)		(1.28)		(6.72)	
Age*Price	1.45***		6.28***		5.45***	
	(0.14)		(1.12)		(1.42)	
Female * Price	-1.45***		-3.14***		-0.95	
	(0.16)		(0.89)		(0.75)	
Income*(Nonstop=0)	-18.12***		-16.42***		-31.78***	
	(1.94)		(3.65)		(4.42)	
Income * Budget	0.45		1.88		-2.16	
	(1.72)		(1.64)		(3.49)	
Female*Budget	-7.25*		-7.28***		-17.45***	
	(4.53)		(2.55)		(4.76)	

Figure 4 Demand estimation results with costumer heterogeneity

Empirical estimation

In a fiercely competitive market, it is expected that the markup for each airline is minimal , and the market is so elastic that raising price is not an option. This would expectedly push the firm to reduce its marginal cost to maintain a competitive edge with its industry rivals. But which costs to cut is the question. In this section, I explore the effects of competition on safety expenses and product-differentiating expenses. An estimation procedure of DDIV (instrumented difference in differences is employed to address endogeneity (reverse causality) between costs and competition.

$$C_{at} = l_a + \pi T_t + \gamma_2 \zeta_{at} + X_{at}\gamma_3 + \varepsilon_{at}$$
$$\zeta_{at} = k_a + \delta_1 T_t + \delta_2 Z_{at} T_t + \eta_{at}$$

The results in both OLS and DDIV shows that with more competition, airlines fly maintains same maintenance expense per aircraft, decreases product-differentiation expenses, operate longer nonstop routes and employ more homogeneous fleets. Cost saving is decreased for consumer experience but not safety. The gravitation towards a homogeneous fleet of planes is justfied, since airlines would only have to train one type of pilot and hire one type of engineer to perform maintenance on their fleets, exploiting economies of scale.

	Maintenance		Food		Other operating expenses		Nonstop distance		Fleet Homogeneity	
	OLS	DDIV	OLS	DDIV	OLS	DDIV	OLS	DDIV	OLS	DDIV
Absolute Own price elasticity	1.04	-0.76	-1.36**	-0.43***	-3.17*	-0.17***	0.318***	0.157***	0.110***	0.014***
	(1.42)	(3.81)	(0.72)	(0.014)	(1.92)	(0.061)	(0.092)	(0.048)	(0.034)	(0.002)
Labor costs	3.26***	2.17*	-	-	-	-	-	-	0.032	0.041***
	(1.05)	(1.43)	-	-	-	-	-	-	(0.025)	(0.009)
Hub %	-	-	-1.08***	1.03*	1.64*	1.35*	-0.151***	-0.271***	-	-
	-	-	(0.35)	(0.68)	(0.98)	(0.77)	(0.022)	(0.485)	-	-
Average Nonstop Distance	5.72**	7.69***	0.86	1.46***	4.29*	1.86***				
	(2.01)	(1.64)	(0.32)	(0.45)	(2.87)	(0.15)				
Nonstop %	4.22***	5.12***	0.44	1.77***	-2.12*	-1.75***				
	(1.02)	(1.86)	(1.19)	(0.41)	(1.65)	(0.47)				

Figure 5 the effects of competition on different costs and operational behavior

Conclusions

In this paper, I estimated the effects of competition on cost behavior and market structure of the airline industry. The estimation is broken into two steps: step one estimates the demand elasticities for the airlines, while step two takes the elasticity derived from step one to evaluate the effect of more competition on costs behavior of the firm and the market structure. Step one shows that the market is increasingly competitive. Step two shows that this competition doesn't significantly affect safety expenses, but it does decrease expense for consumer experience, aka product differentiation expense.

References

1. **Richard Olivier Armantler Olivier.** Domestic airline alliances and consumer welfare. RAND Journal of Economics, 2008.
2. **Pakes Berry, Lehvinson.** Automobile prices in market equilibrium. Econometrica, 1995.
3. **Steven Berry and Panle Jia.** Tracing the woes: An empirical analysis of the airline industry. American Economic Journal: Microeconomics, 2010.
4. **Steven T. Berry.** Airport presence as product dierentiation. American Economic Review, 1990.
5. **Severin Borenstein.** Airline mergers, airport dominance, and market power. Amer- ican Economic Review, 1990. 21
6. **Severin Borenstein.** Why can't us airline make money? American Economic Review: Papers and Proceedings, 2011.
7. **Jan Brueckner and Pablo T. Spiller.** Economies of traffic density in the deregulated airline industry: Journal of Law and Economics; 1994
8. **Nichola J. Dyer Brueckner, Jan and Spiller**. Fare determination in airline hub-and-spoke networks. The RAND Journal of Economics, 1992.
9. **Federico Ciliberto and Jonathan W Williams.** Does multimarket contact facilitate tacit collusion? inference on conduct parameters in the airline industry. The RAND Journal of Economics, 2014
10. **David Sibley David Graham, Daniel Kaplan.** Eciency and competition in the airline industry. The Bell Journal of economics, 1983.
11. **P. G. Gayle.** An empirical analysis of the competitive effects of the delta/ continental/ northwest code share alliance, Journal of Law and Economics; 2008
12. **Mara Lederman.** Do enhancements to loyalty programs affect demand? the impact of international frequent yer partnerships on domestic airline demand. RAND Journal of Economics, 2007.