The Effect of the Internet on Performance and Quality: Evidence from the Airline Industry

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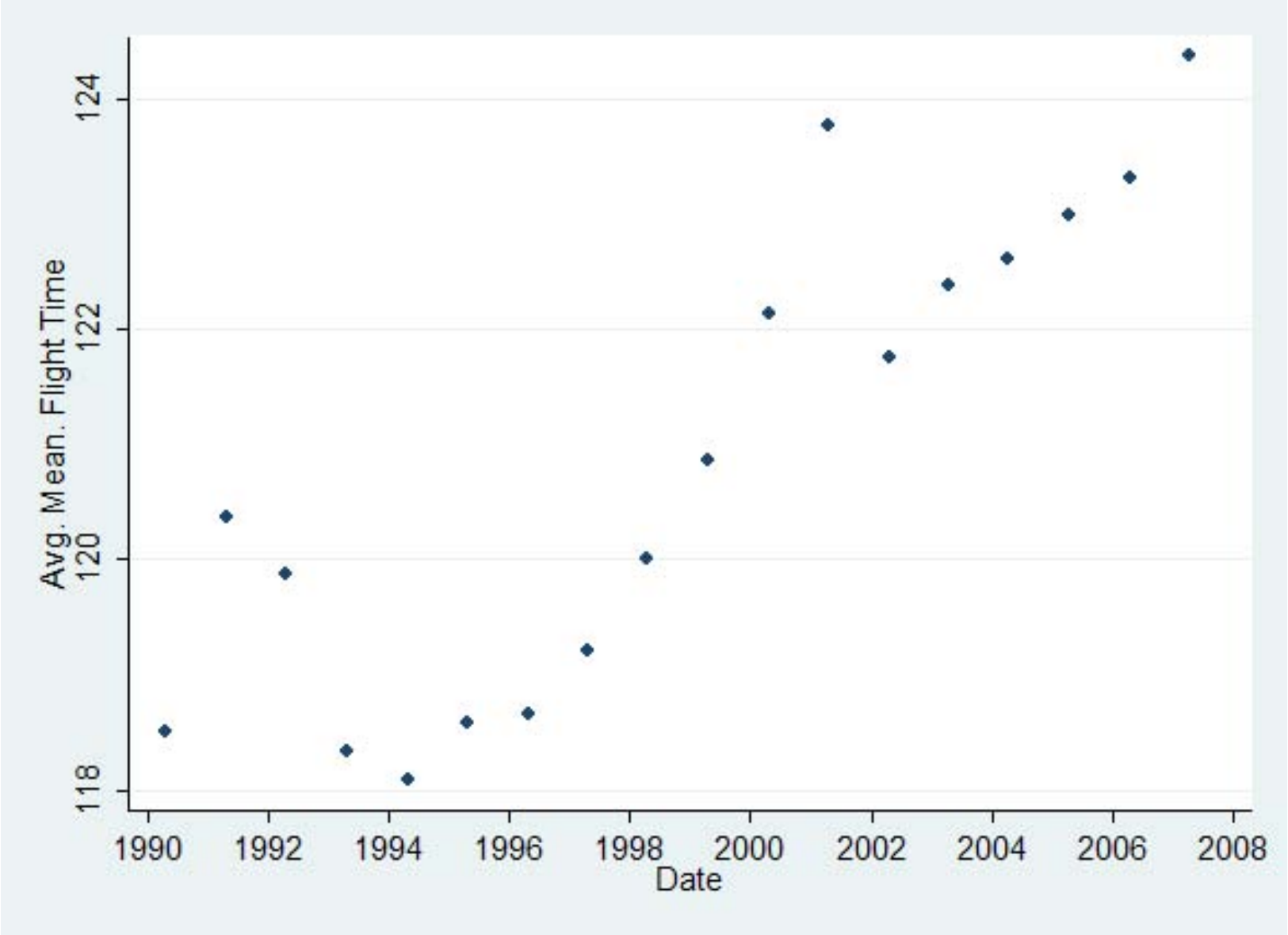
- But, besides setting lower prices, how do firms respond?
- Did the Internet affect performance or product quality? How?

The Internet and the US Airline Industry

- In 1997, 0.5% of US domestic airline tickets were sold online compared to ∼60% in 2007
- Roughly 35% of the traditional travel agencies exited their markets
- Airfares fell more in areas with higher Internet access

Mean Scheduled Flight Duration (1990 - 2007)



The Internet and Scheduled Flight Duration

Change in the Mode of Competition

- Before the Internet, flights on a travel agent screen were typically sorted by duration (80% of flights were booked from the first screen)
- Consequently, airlines competed on flight duration
- However, once flights are typically sorted by price the return to shorter flight duration decreases
- Airlines invest fewer resources at obtaining shorter flight durations

American Airlines' Capacity Planning MD:

> *(Before the Internet) you had to be on the first screen. All the booking came off the first screen. You'd bring your airplanes in as fast as you can and you'd let them go as fast as you can. (When most tickets are sold online), it isn't important to have the fastest elapsed time.*

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ATW online, November 2002

What Do We Do?

- Provide evidence on the relationship between Internet access and scheduled flight duration
- Show how this relationship varies with the nature of competition
- Examine the effect of the Internet on flight delays, a common measure for flight quality

Main Data Sources

- On-time performance data - flight level data that include scheduled and actual flight times and information on carrier, origin, destination and aircraft type
- Internet usage data across US MSAs for 1997, 1998, 2000, 2001, 2003 and 2007
- Origin and destination price data - to compute 1) average fare and 2) the distribution of passengers' origin airport

Variation

We exploit three main sources of variation to identify the effect of the Internet on scheduled and actual flight times:

1. Differences in Internet penetration over time
2. Differences in Internet penetration across the US
3. Differences in the competitive level across markets

Internet Measure

How to measure Internet usage on Delta's Flight from Atlanta to Denver?

Internet - Stylized Example

Delta's Flight from Atlanta to Denver

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Delta's Flight from Atlanta to Denver

Origin	Passenger Share	Internet
Atlanta	18%	40%
Philadelphia	8%	50%
Boston	8%	60%
Orlando	8%	20%
Miami	8%	20%
Denver	50%	50%
Weighted Average		43.4%

Estimation

The basic framework is a panel data fixed-effects regression

$$Duration_{fijt} = \beta_1 In_{ijt} + \beta_2 HHI_{jt} + \beta_3 In_{jt} * HHI_{jt} + \beta_4 ln(Fare_{ijt}) + \beta_c X^c_{fijt} + \alpha_j + \theta_{acft} + \delta_{it} + \mu_{ki} + \epsilon_{fijt}$$

flight f by airline i on directional segment j on day t

- X^c_{fijt} - congestion controls (# of flights)
- α_j - directional airport-pair (flight distance and direction)
- θ_{acft} - type of aircraft (speed, fuel-efficiency)
- δ_{it} - carrier-day (differences across airlines' scheduling decisions)
- μ_{ki} - origin-carrier (number and location of gates)

Identification

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- Two features strengthen this identification strategy:
  1. Different competition levels across flight segments originating from the same airport
  2. Flights departing from the same airport carry passengers who began their journey at different airports/MSAs

Dependent Variable - Scheduled Flight Duration

Dependent Variable:	ELAPSED SCHEDULED TIME, mins					
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	IV	OLS	OLS	IV
INTERNET	4.209***	3.865***	3.795***	3.297***	3.114**	3.080**
	(1.300)	(1.281)	(1.284)	(1.230)	(1.221)	(1.225)
HHI	1.288***	1.775***	1.807***	1.546***	1.905***	1.907***
	(.491)	(.493)	(.495)	(.483)	(.483)	(.483)
INTERNET * HHI	-3.115***	-3.296***	-3.293***	-3.085***	-3.228***	-3.215***
	(.669)	(.662)	(.663)	(.663)	(.655)	(.656)
LOG (AVG. FARE)		-1.705***	-1.842***		-1.358***	-1.394***
		(.263)	(.280)		(.240)	(.256)
Segment Fixed Effects	Y	Y	Y	Y	Y	Y
Aircraft Fixed Effects	Y	Y	Y	Y	Y	Y
Demographic Controls (X^D)	Y	Y	Y	Y	Y	Y
Addl' Congestion Controls (X^C)	Y	Y	Y	Y	Y	Y
Carrier/Day Fixed Effects	Y	Y	Y	Y	Y	Y
Origin/Carrier Fixed Effects	N	N	N	Y	Y	Y
Observations	286,004	286,004	285,509	286,004	286,004	285,509

Notes: Standard errors are in parentheses. Stars denote the significance level of coefficients: *** - 1 percent, ** - 5 percent, * - 10 percent. Standard errors are clustered within a segment. Additional control variables are described in the text.

Flight Duration and Market Competition

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1. Before the Internet - airlines were mostly interested in the flights with the shortest scheduled duration
   - The Internet coefficient is greater for the shortest flights on a segment
2. In markets with low-cost carriers price has always been 'more important' than flight duration
   - We do not find the same effect of the Internet in markets with low-cost-carriers

How Internet and Flight Delays Related?

As Internet use increases – price competition ensues and product quality will

- Improve because: 1. passengers using the Internet can compare flight delays across airlines; 2. scheduled times are longer
- Worsen because firms compete vigorously at the price dimension at the expense of the less salient measures of product quality
- Which effect dominates?
- Does competition mitigate or exacerbate the net effect?

Dependent Variables - Arrival Delays

Dependent Variable:	ARRIVAL DELAY, mins					
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	IV	OLS	OLS	IV
INTERNET	10.372**	9.807**	9.832**	9.674**	9.366**	9.446**
	(4.254)	(4.206)	(4.210)	(4.309)	(4.273)	(4.279)
HHI	1.414	2.228	2.421	1.952	2.644*	2.816*
	(1.585)	(1.605)	(1.613)	(1.587)	(1.605)	(1.613)
INTERNET * HHI	-6.416***	-6.701***	-6.854***	-6.856***	-7.116***	-7.260***
	(2.252)	(2.250)	(2.254)	(2.257)	(2.255)	(2.259)
LOG (AVG. FARE)		-2.741***	-3.159***		-2.536***	-2.921***
		(0.745)	(0.811)		(0.775)	(0.852)
Segment Fixed Effects	Y	Y	Y	Y	Y	Y
Aircraft Fixed Effects	Y	Y	Y	Y	Y	Y
Demographic Controls (X^D)	Y	Y	Y	Y	Y	Y
Addl' Congestion Controls (X^C)	Y	Y	Y	Y	Y	Y
Carrier/Day Fixed Effects	Y	Y	Y	Y	Y	Y
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Concluding Remarks

- We are not aware of previous studies on the relationship between quality/perfromace and search costs or Internet usage
- We find that performance and quality fell on markets where more passengers were likely to purchase their tickets on-line. The effect of the Internet is larger on more competitive markets
- The magnitude of our results are in line with other studies on the effect of market structure on airline performance (e.g. Mayer and Sinai 2003, Forbes and Lederman 2010)
- Our results also illustrate how firms respond to the criterion/dimension used by customers