



CENTER FOR ADVANCED AVIATION SYSTEM DEVELOPMENT (CAASD)

# ***Delay, Complaints, and Fare in a Simultaneous Model of Domestic NAS***

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Asilomar Conference Center, Pacific Grove CA  
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# Breaking All Records in Delays



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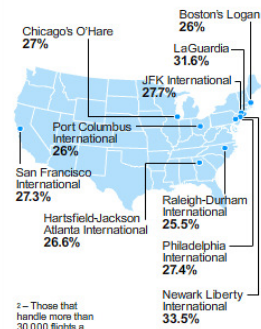
## Airline delays set record in 2006

Updated 1/26/2007 2:35 PM ET

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By Alan Levin, USA TODAY

Large airports with the highest percentage of delayed flights January-November 2006.



Airline delays increased sharply last year to record highs because of a rash of bad weather starting in the fall that shut airports and stranded thousands of passengers, according to federal data obtained by USA TODAY.

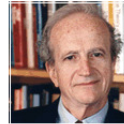
By several measures, airline delays exceeded those in 1999 and 2000, when thunderstorms created such chaos in schedules that passengers revolted and Congress threatened to take action against carriers.

### TIPPING POINT: Conditions for passengers

The rise in delays demonstrates that the system is becoming more vulnerable to airport snarls as flights increase in crowded cities such as New York, Chicago and Atlanta. The data also show the system has improved in some ways. Last summer, for example, delays never reached the peaks of 2000. Summer typically has the most delays because of thunderstorms.

Aircraft were delayed 22.1 million minutes last year, Federal Aviation Administration records show. That translates to delays of at least 15 minutes for 22% of flights on large airlines through November, according to the most recent data from the federal Bureau of Transportation Statistics.

New York's three airports led the nation in the percentage of late flights through November, according to the federal data. At Newark, one-third of arrivals on major airlines were at least 15 minutes late.



## THE BECKER-POSNER BLOG

A BLOG BY GARY BECKER AND RICHARD POSNER



### ENTRY ARCHIVE

August 12, 2007

#### Air Transportation Delay--Posner

This summer has seen a significant degradation in the quality of airline transportation in the United States compared with the recent past--substantial increases in delayed and canceled flights, in missed connections, in waiting time to the next flight to one's destination if one's original flight is canceled, in crowding in planes, in poor in-flight service, and in lost luggage. The delays have actually been masked by the airlines' practice of increasing scheduled times--for example, flights from Chicago to Washington, D.C. used to be scheduled to take an hour and a half, but now are scheduled to take almost two hours, yet still are late more often than when the schedule called for a faster trip.

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Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

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## Delays Hurt Airlines' Capitol-Hill Connections

Push to Boost Fees On Corporate Jets Flags in Congress

By CHRISTOPHER KONKEY  
August 8, 2007; Page A6

WASHINGTON -- Canceled flights, lengthy delays and heightened security concerns have turned air travel into a maddening experience for many fliers. Now, the same problems are making life difficult for commercial airlines on Capitol Hill.



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### HOT TOPIC

## Why the Skies Have Gotten Crowded

By SARAH NASSAUER  
July 21, 2007; Page A5

Data this past week validated what many fliers already suspected -- the number of delays and cancellations in June may have been the worst ever. According to FlightStats.com, 20,301 flights were canceled in the U.S., more than double the number grounded in June 2006. Among the 40 largest U.S. air carriers, more than 30% of flights scheduled to land in the U.S. arrived late.

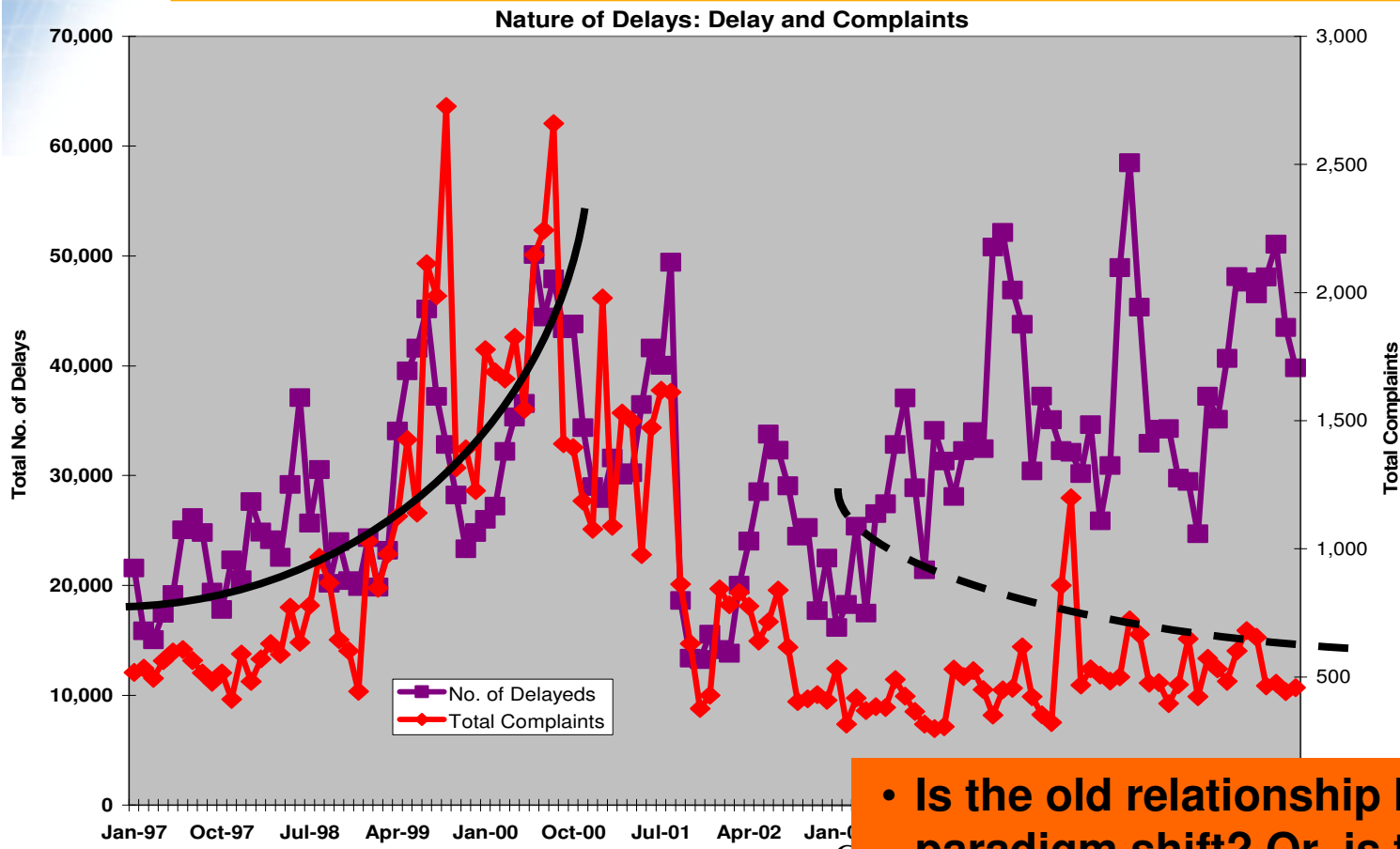
### MORE

- Review & Outlook: Gridlock in the Air
- Question of the Day: What's the biggest hassle with air travel?

Between January and May of this year, about 74% of flights arrived on time, the lowest percentage since the Bureau of Transportation Statistics started keeping this measure in 1995.



# Why Aren't They Complaining More?



*“We are surprised people aren't complaining more”*

Prof. John Hansman, Aeronautics and Astronautics, MIT; quoted in *Why the Skies Have Gotten Crowded*, Sarah Street

**• Is the old relationship broken, a paradigm shift? Or, is this a temporary phenomenon?**

Data Sources:

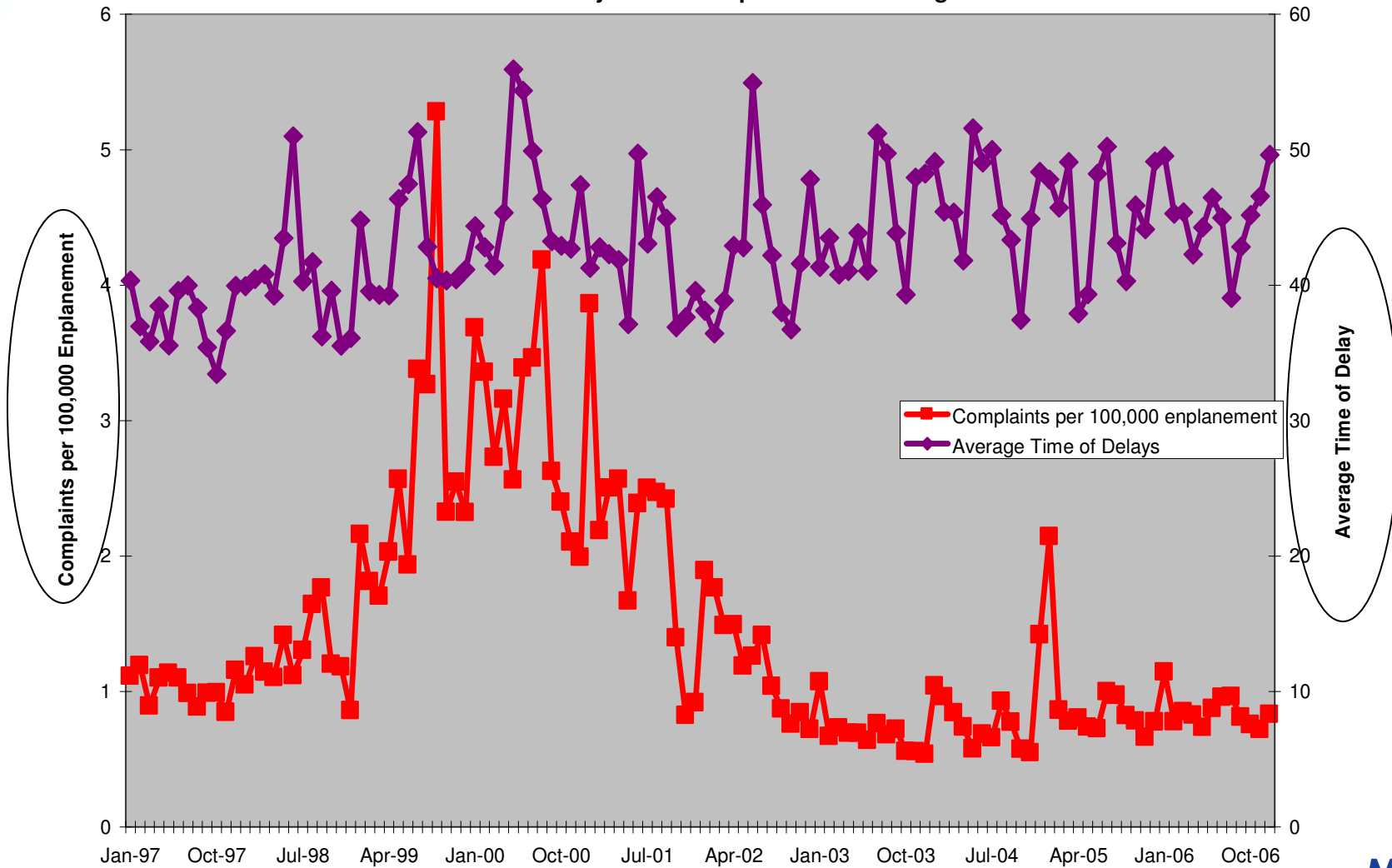
Monthly total delay: OPSNET count of total number of delayed flights;  
Total complaints: Composite of airline passengers' complaints from Airline Consumer Report. See the last page for definition and sources of all variables





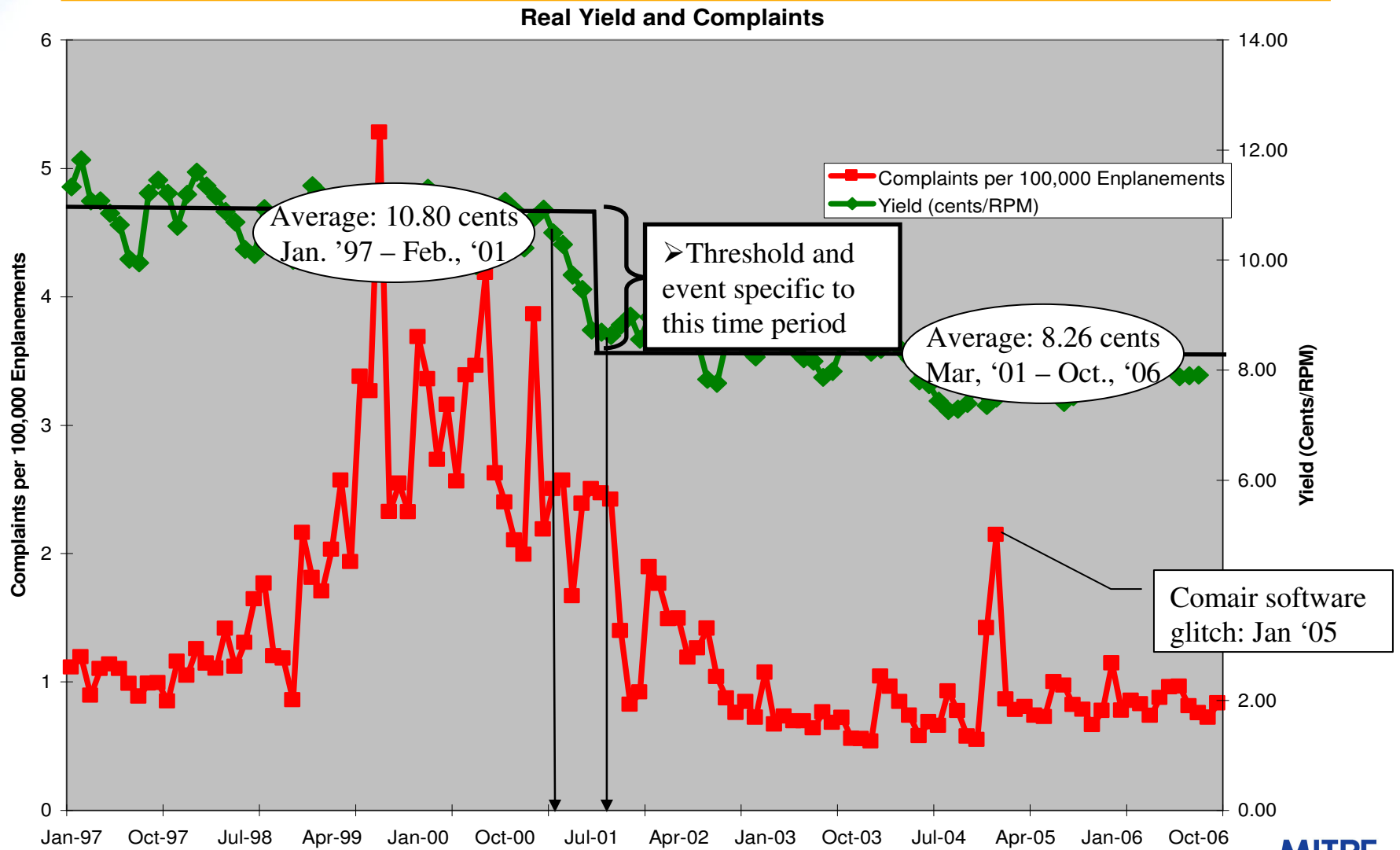
# Passengers Who Are Delayed, Average Time of the Delayed Flights Seems to Have Not Changed

Nature of Delays: Unit Complaints and Average Time





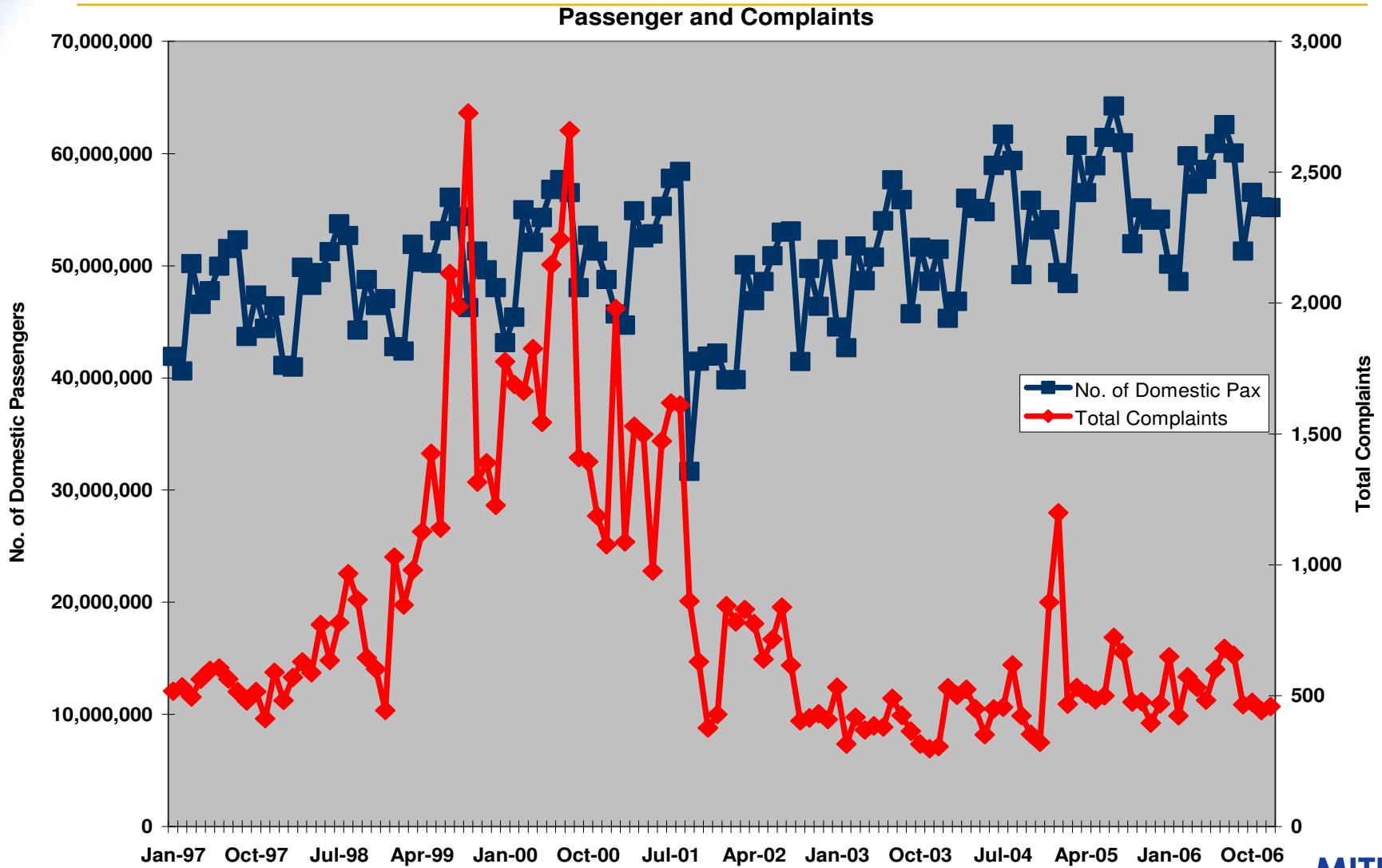
# We Complain More If We Pay More: *We (Expect To) Get What We Pay For*

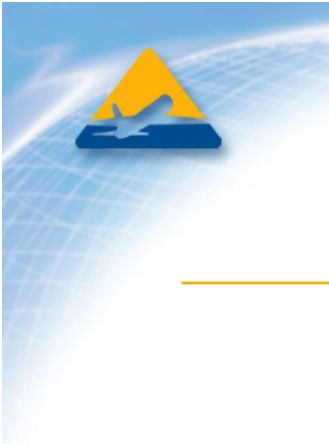


Average real yield: RPM adjusted for distance and normalized to 1990 CPI; Air Transport Association

March, '01 Sept, '01

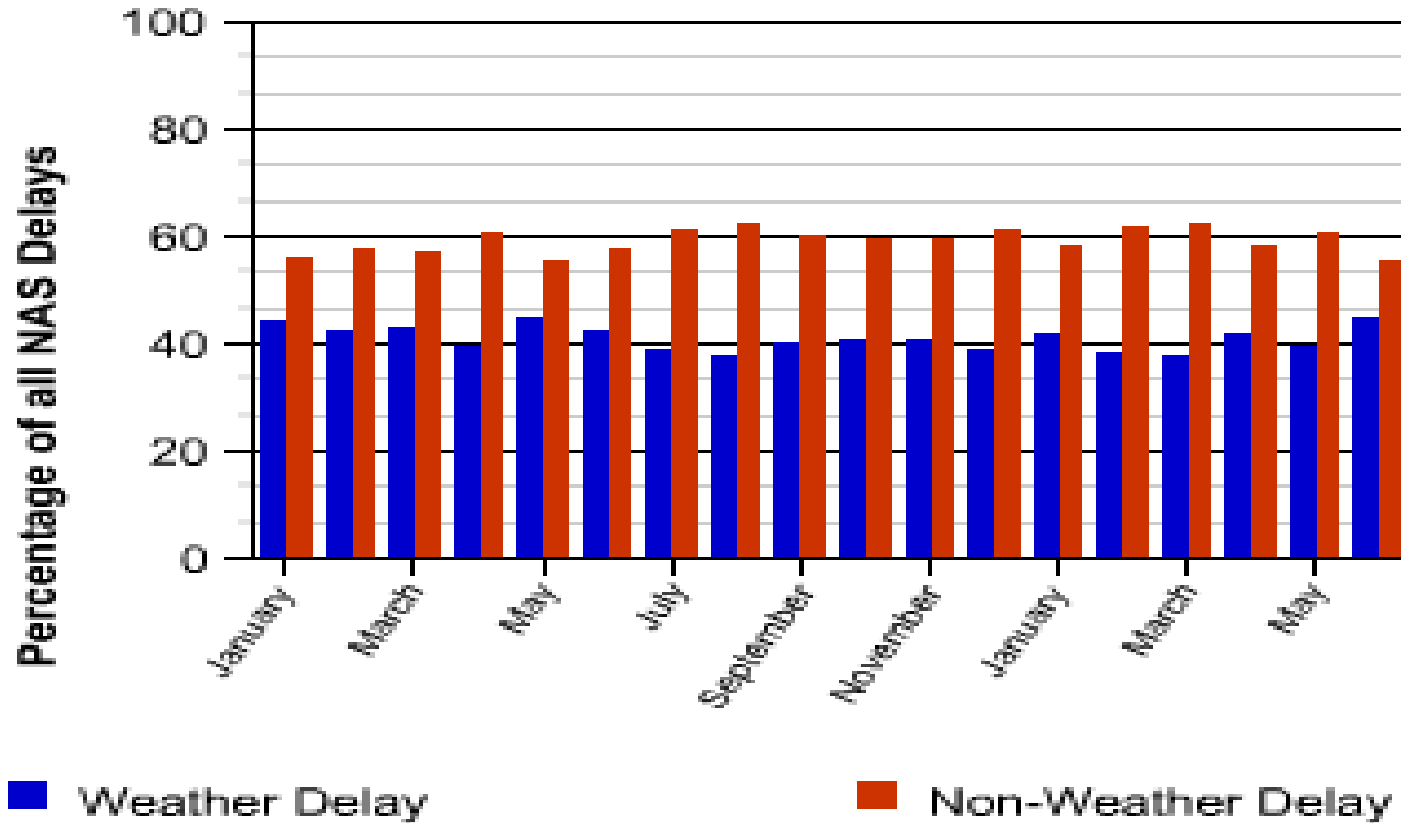
# Passenger and Complaints: Declining Complaints Are Even More Striking With Increasing Number of Passengers





# Recap and Key Empirical Question

**Weather's Share of Delayed Flights National (January, 2006 - June, 2007)**



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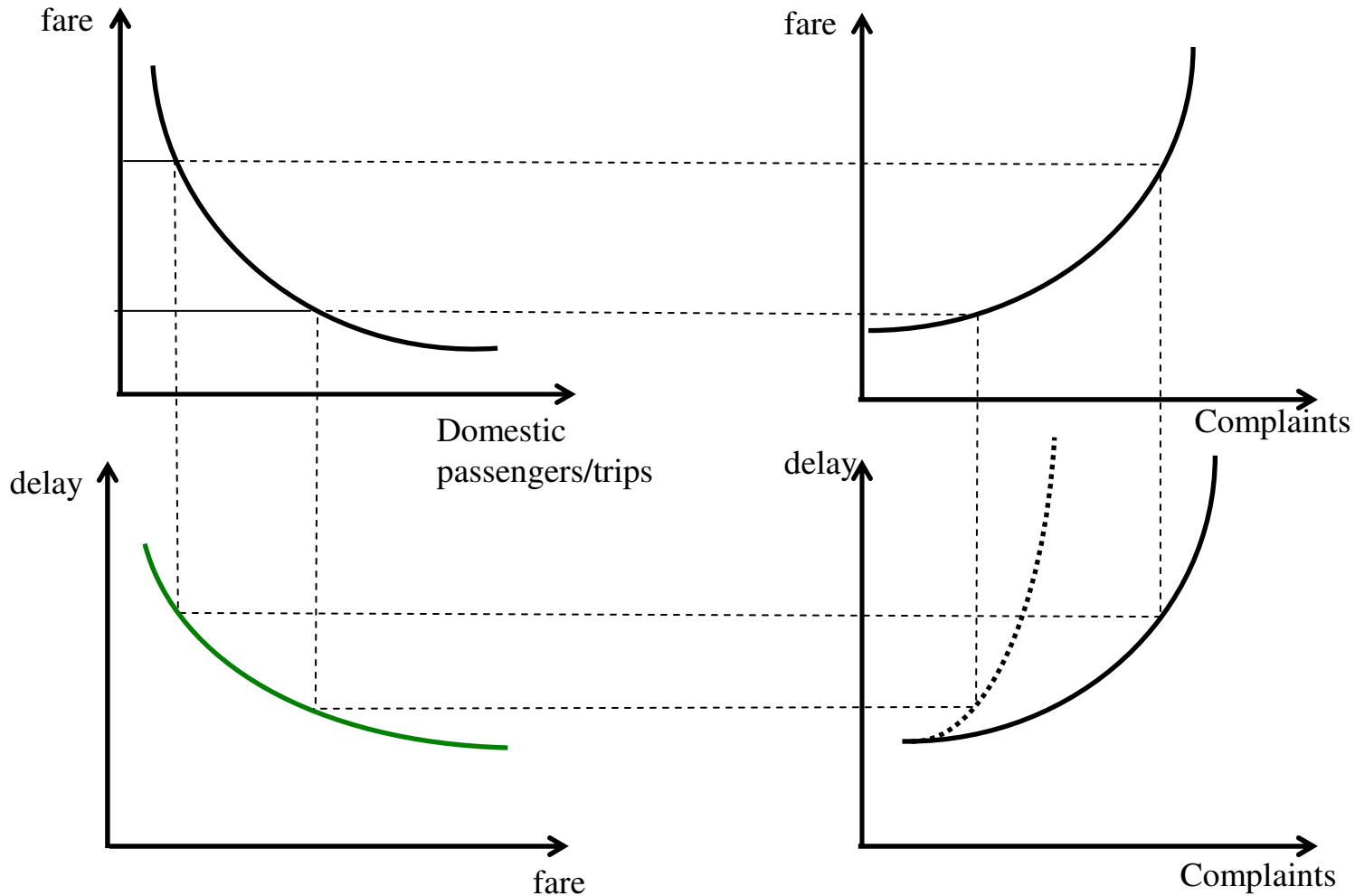
2001

e

ess



# A Proposed Analytical Framework to Capture *Fare and Delay Trade-Off*



Compensated demand-delay function: *Compensated by lower fare for increased delays but less complaints*





# Empirical Framework Determining Fare, Complaints and Delay Simultaneously

- **Inverse demand function: Market demand facing airlines**
  - Fare = f (domestic passengers; composite effects;  $\epsilon_f$ )
    - H0: Domestic passengers (-); composite effects consisting of March, 2001 economy slowdown and 9/11 (-)
  
- **Complaints function: Passengers' trade-off (fare and delay) that results in optimal number of complaints**
  - Complaints = f (Fare; Delay; Domestic departures by US carriers;  $\epsilon_\chi$ )
    - H0: fare (?); delay (?); domestic departures (?)
  
- **Delay function: NAS operations result in delay**
  - Delay = f(Terminal volume delays; Center volume delays, Actual block time; Summer dummy;  $\epsilon_\delta$ )
    - H0: Terminal volume delays (+); center volume delays (+); actual block time (+); summer dummy (+)



## Methodology and Data (Definitions and sources are at the last page)

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- **Demand function data**
  - Monthly passenger data from the Bureau of Transportation Statistics (BTS) of the Department of Transportation (DOT); and Air Transportation Association for yield information
- **Complaints function data**
  - Air Travel Consumer Reports: DOT
- **Delay function data**
  - FAA/APO's ASPM
- **Methodology: Non-linear Iterative Simultaneous Equation System**
  - Ordinary least squares methodology suffers from simultaneity bias (e.g., endogenous delay may depend on  $\varepsilon_x$ )
  - Fare, delay, and complaints are, in fact, determined simultaneously
  - Iterative process begins with OLS parameter estimates and improves the estimation in subsequent steps



# Statistical Model: Empirical Results for Logarithmic Specification

You (Expect To) Get What You Pay For:  
Delay, Complaints, Fare in a Simultaneous Model

12:56 Friday, August 24,

The MODEL Procedure

Nonlinear ITSUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
IReal_yield	3	115	0.3948	0.00343	0.0586	0.8470	0.8443
IComplaints	4	114	17.3973	0.1526	0.3907	0.4986	0.4854
IDelay	5	113	4.7728	0.0422	0.2055	0.7668	0.7585

Nonlinear ITSUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr >  t	Label
a1	6.685277	0.8255	8.10	<.0001	Fare intercept
a11	-0.2433	0.0466	-5.22	<.0001	effect of pax on fare
a12	-0.25455	0.0113	-22.54	<.0001	composite dummy and its impact on fare
b2	12.78061	6.1633	2.07	0.0404	complaint intercept
b21	1.118043	0.4544	2.46	0.0154	effect of real yield on complaints
b23	0.982649	0.0999	9.84	<.0001	effect of delay on complaints
b24	-1.66839	0.4249	-3.93	0.0001	effect of domestic departures on complaints
c1	-75.5369	8.2811	-9.12	<.0001	delay intercept
c21	0.186221	0.0409	4.55	<.0001	terminal volume effect on delay
c22	0.24451	0.0315	7.76	<.0001	en route volume effect on delay
C16	18.04152	1.7537	10.29	<.0001	effect of actual block time on delays
C17	0.502808	0.0391	12.87	<.0001	effect of summer on delays

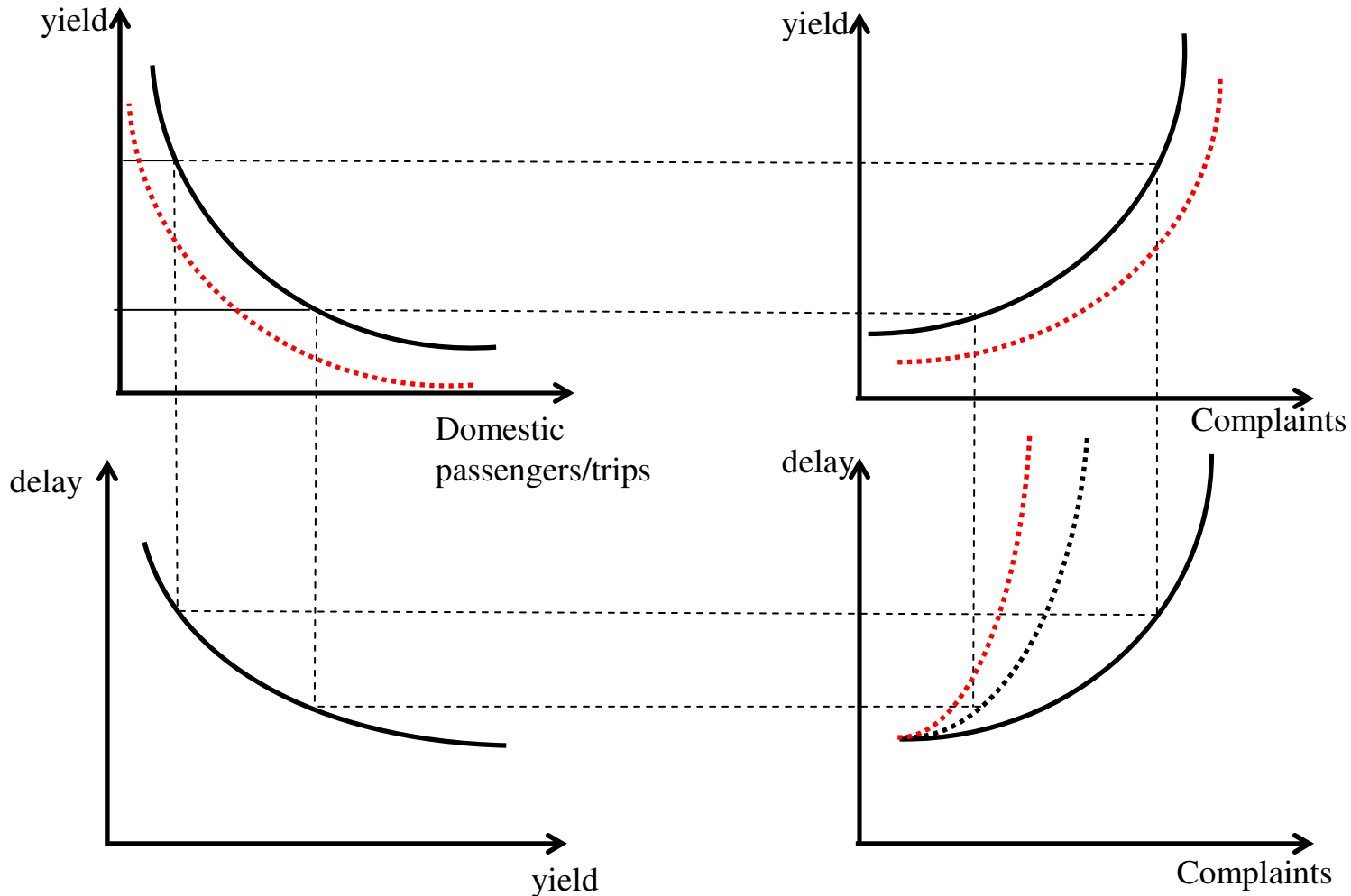
Inverse Demand Function

Complaints Function

Delay Function



# Estimated Results Confirm the Proposed Analytical Framework



Effect of negative shocks (e.g., recession of '01, 9/11) on yield, complaints and delay



## ***Comfort for Lower Fares: Nature of Trade-Off***

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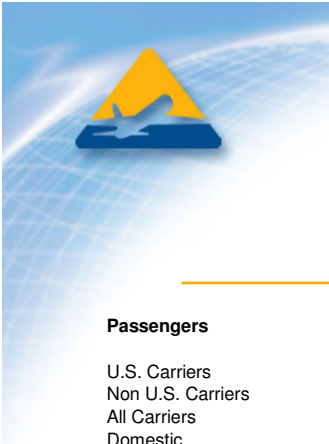
- ***“Crowding reflects the success of deregulation, not its failure. Competition in the unregulated market has proved to the satisfaction of the carriers that most travelers are willing to sacrifice comfort for lower fares.”***
  - Alfred Kahn, the last chairman of the Civil Aeronautics Board before deregulation; *Why the Skies Have Gotten Crowded*, Sarah Nassauer, *July 21, 2007; Page A5; Wall Street Journal*
- **Furthermore, access to technology (e.g., wifi, blackberry) has made the delayed time utilized more efficiently than before leading to less complaints**



# Concluding Comments

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- **Congress is considering several bills mandating airline passengers' rights, including**
  - **Right to disembark when an aircraft is sitting on the tarmac more than 3 hours**
  - **Right to food, water and clean bathrooms if stranded on the tarmac**
  - **Right to receive accurate and timely information about delayed flights, diverted and canceled flights**
- **The airlines oppose mandated bill of rights. After all, legislations lead to increased cost. Given the market competitiveness, this may further put pressure on the bottom line and/or fare**
- **Depending on the elasticities of demand and supply, fare may increase and/or decrease resulting in more (less) complaints in the future**
- **A paper will be shortly available giving the analytical and empirical framework, results and other details**



# Data and Sources

## Passengers

U.S. Carriers  
 Non U.S. Carriers  
 All Carriers  
 Domestic  
 International  
 System Wide

## T100 Market

[http://www.transtats.bts.gov/databases.asp?Mode\\_ID=1&Mode\\_Desc=Aviation&Subject\\_ID2=0](http://www.transtats.bts.gov/databases.asp?Mode_ID=1&Mode_Desc=Aviation&Subject_ID2=0)

U.S. air Carriers  
 Foreign air carriers  
 Sum of U.S. and Non U.S. Carriers  
 both origin and destination airports are located within the boundaries of the United States and its territories  
 at least one point of service is in the United States or one of its territories.  
 Sum of Domestic and International

## Departures

## T100 Market

[http://www.transtats.bts.gov/databases.asp?Mode\\_ID=1&Mode\\_Desc=Aviation&Subject\\_ID2=0](http://www.transtats.bts.gov/databases.asp?Mode_ID=1&Mode_Desc=Aviation&Subject_ID2=0)

Categories are the same as those for Passengers but the metric accounts for flights as opposed to individual passengers

## Fares

## Air Transport Association

<http://www.airlines.org/economics/finance/monthly+yields.htm>

Data reflects aggregated monthly data for the following U.S. airlines: Alaska (AS), America West (HP), American (AA), Braniff (BN), Continental (CO/CS), Delta (DL), Eastern (EA), Northwest (NW), Pan Am (PA), Piedmont (PI), Republic (RC), Trans World (TW), United (UA), US Airways (US), Western (WA)

### DOMESTIC

¢/RPM  
 CPI  
 Value  
 % Chg. YOY from 1990  
 Normal ¢/RPM 1990 Value

average cents per revenue passenger mile for domestic flights  
 consumer price index value  
 percent change from current year compared to CPI value at 1990  
 ¢/RPM normalized to value equivalent to 1990 value of money

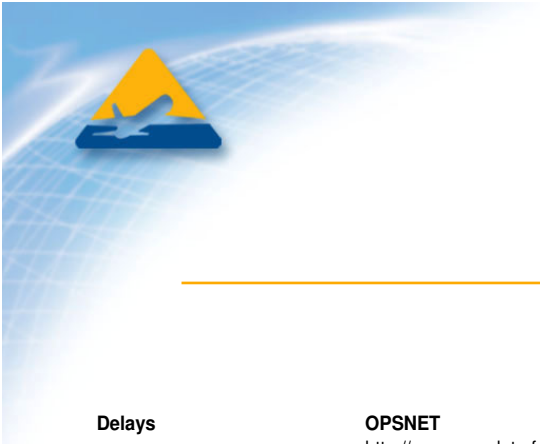
## Complaints

<http://airconsumer.ost.dot.gov/reports/index.htm>

Complaints are against U.S. airlines

Flight Problems  
 Oversales  
 Ticketing/Boarding  
 Fares  
 Refunds  
 Baggage  
 Customer Service  
 Disability  
 Smoking  
 Advertising  
 Credit  
 Tours  
 Discrimination  
 Animals  
 Other  
 Total Complaints  
 System Wide Passengers

Cancellations, delays, or any other deviations from schedule, whether planned or unplanned  
 All bumping problems, whether or not the airline complied with DOT oversale regulations  
 Airline or travel agent mistakes made in reservations and ticketing; problems in making reservations and obtaining tickets due to busy telephone lines or waiting in line, or delays in mailin  
 Incorrect or incomplete information about fares, discount fare conditions and availability, overcharges, fare increases and level of fares in general.  
 Problems in obtaining refunds for unused or lost tickets, fare adjustments, or bankruptcies.  
 Claims for lost, damaged or delayed baggage, charges for excess baggage, carry-on problems, and difficulties with airline claims procedures.  
 Rude or unhelpful employees, inadequate meals or cabin service, treatment of delayed passengers.  
 Civil rights complaints by air travelers with disabilities  
 Inadequate segregation of smoker from non-smokers; failure of airline to enforce no-smoking rules; objections to the rule, would prefer change such as; (1) relaxation or elimination of req  
 Advertising that is unfair, misleading or offensive to consumers.  
 Denial of credit, interest or late payment charges, incorrect billing, or incorrect credit reports on airline-issued credit.  
 Problems with scheduled or charter tour packages.  
 Civil rights complaints by air travelers (other than disability); for example, complaints based on race, national origin, religion, etc.  
 Loss, injury or death of an animal during air transport provided by an air carrier.  
 Frequent flyer, smoking, tours credit, cargo problems, security, airport facilities, claims for bodily injury, and others not classified above.  
 Sum of all categories of complaints listed above  
 Passengers on U.S. Carriers, domestic and international flights



# Data and Sources

## Delays

- Total Delays
- Delays By Category
- Departure
- Arrival
- En Route
- TMS

### Delays By Class

- Air Carrier
- Air Taxi
- General Aviation

### Delays By Cause

- Weather
- Term Vol
- Center Vol
- Equip
- Runway
- Other
- Avg Time (Min)
- Total Time (Min)

## OPSNET

<http://www.apo.data.faa.gov/opsnet/mainOPSNET.asp>  
Sum of delays from Category, Class, or Cause

An aircraft with seating capacity of more than 60 seats or a maximum payload capacity of more than 18,000 pounds carrying passengers or cargo for hire or compensation. This includes Aircraft designed to have a maximum seating capacity of 60 seats or less or a maximum payload capacity of 18,000.pounds or less carrying passengers or cargo for hire or compensation. All civil aircraft, except those classified as air carriers or air taxis.

Average delay of flights in minutes (not sure if for all flights or all delayed flights)  
Sum of delay of all flights in minutes

## Block Time

- ScheduledBlock
- ActualBlock
- Airborne
- TAXIOUT
- PBKDEL
- ATGDEL
- Block Delay

ASQP:  
<http://www.apo.data.faa.gov/asqp/entryASQP.asp>  
Scheduled elapsed flight time (from aircraft pushback to gate arrival)  
Actual elapsed flight time (from aircraft pushback to gate arrival)  
Actual block time phase in the air (ie excluding taxi out and taxi in)  
Elapsed time from aircraft pushback to wheels off  
Departure delay from schedule (Actual departure time - Scheduled departure time)  
Arrival delay from schedule (Actual arrival time - Scheduled arrival time)  
Difference in ActualBlock and ScheduledBlock