Delays and fares at John Wayne Airport

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Introduction

What is the impact of delays on prices at John Wayne Airport, California?

Motivation :
"The effect of air traffic delays on airline prices", S. J. Forbes at LaGuardia.
LaGuardia, airport regulation since 1969:

- landing and take-off restrictions;
- entry restrictions and prices above the competition level.

After the Aviation Investment and Reform Act, voted in March 2000: relaxing restrictions $\Rightarrow$ congestion at LaGuardia.

Why John Wayne Airport?

- regulated by the 1985 Settlement Agreement: restriction of aircraft access and limits of noise;
- amendment in 2003 allowing more flights.

Our main result: Delay increases by one minute $\Rightarrow$ Price decreases by \$1.23.

Figure: Location of John Wayne Airport

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Delay data

Origin: "On-Time Performance Data" from US Department of Transportation.

Variables of interest :

- month, year;
- route characterisics : origin/destination airports, carrier, distance;
- actual departure and arrival times (local time);
- departure and arrival delays (=actual-scheduled time⇒ early departure recorded as negative).

The 10% of flights with the highest departure delays in January 2011

Linear regression of departure delay on distance, time, carrier and competition

$$\begin{aligned}\widehat{DEPDELAY_i} = {} & 4.54 \times 10 + 6.87 \times 10^{-3} DISTANCE_i - 5.62\, TIMESLOT\_612_i \\ & - 5.99\, TIMESLOT\_1722_i + 5.31 AS_i - 2.82 CO_i + 1.47 \times 10^{-1} DL_i \\ & - 1.41 F9_i + 1.75 OO_i + 5.08 UA_i + 4.64 US_i - 2.04 WN_i \\ & - 3.97 YV_i + 8.34 COMPET_i \end{aligned} \quad (1)$$

- Scheduled departure between 6am and 12am $\Rightarrow$ departure delay decreases by 5.62 minutes.
- Scheduled departure between 5pm and 10pm $\Rightarrow$ departure delay decreases by 5.99 minutes.
- Flight operated by SkyWest $\Rightarrow$ departure delay increases by 1.75 minutes in comparison with AA.
- Competition on the route $\Rightarrow$ departure delay increases by 8.34 minutes.

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Fare data

Origin: parsed DB1B Coupon and Ticket data from US Department of Transportation.

Variables of interest:

- Quarter, year;
- Some route characteristics: Origin, Destination and Distance;
- The operator and marketshare on the route;
- The class and price of the ticket;
- The number of passengers on the route.

Price on fareclass, distance and competition

$$\widehat{PRICE}_i = 9.44.10^2 - 8.11.10^2 ECO_i + 1.29.10^{-1} DISTANCE_i - 7.55.10^1 COMPET_i \quad (2)$$

- Distance increases by 100 miles $\Rightarrow$ Price increases by \$13;
- Economy class $\Rightarrow$ Price decreases by \$811.

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Global approach

- Step 1: Collect fare dataset from 1999 to 2010;
- Step 2: Download delay dataset from 1999 to 2010;
- Step 3: Python code:
  - Delay textfiles for each month with variables of interest;
  - Gather months to have one delay file by quarter, creating new variables;
  - Arrange fare data;
  - Merge the two datasets quarter by quarter;
  - Aggregate quarters in a textfile.
- Step 4: Analyse with EViews.

Merge variables

Relevant initial variables:

- Year, quarter;
- Characteristics of the route;
- Class and mean price of ticket.

Relevant constructed variables:

- Mean departure/arrival delay;
- 90% quantile of departure/arrival delay.

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Carriers operating at SNA

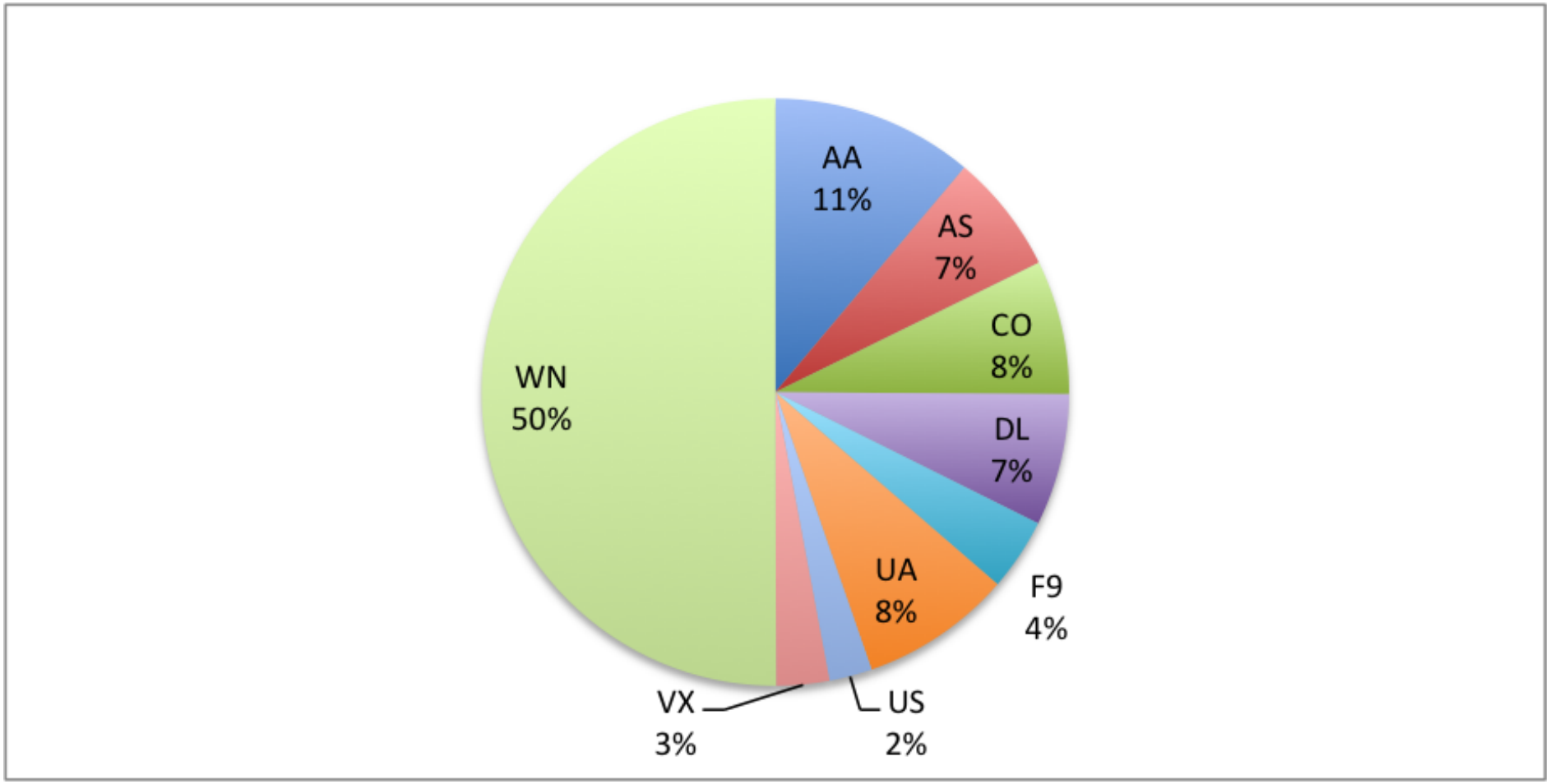

Figure: Carriers market share (number of pax) at SNA (2010:2).

Departure/arrival delays at SNA

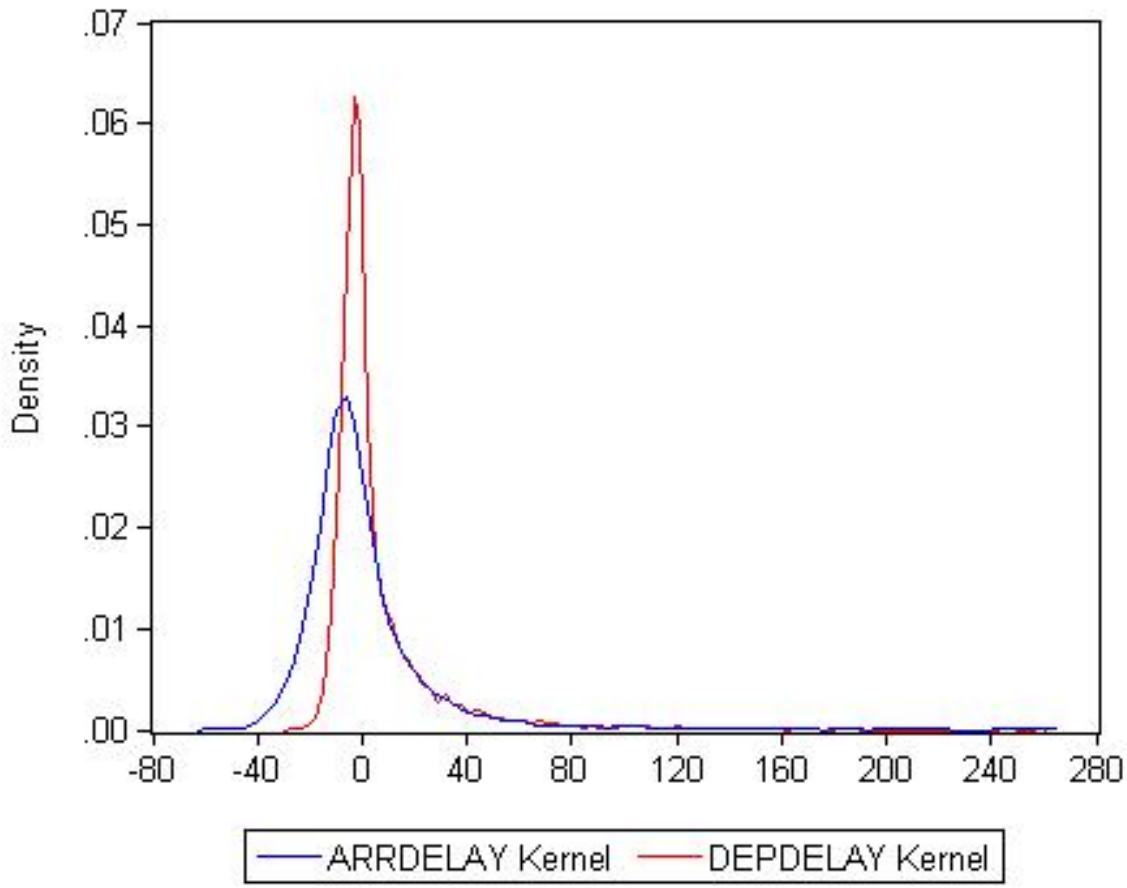

Figure: Departure and arrival delays for all departure/arrival flights to/from SNA (2010:2).

Departure/arrival delays at SNA

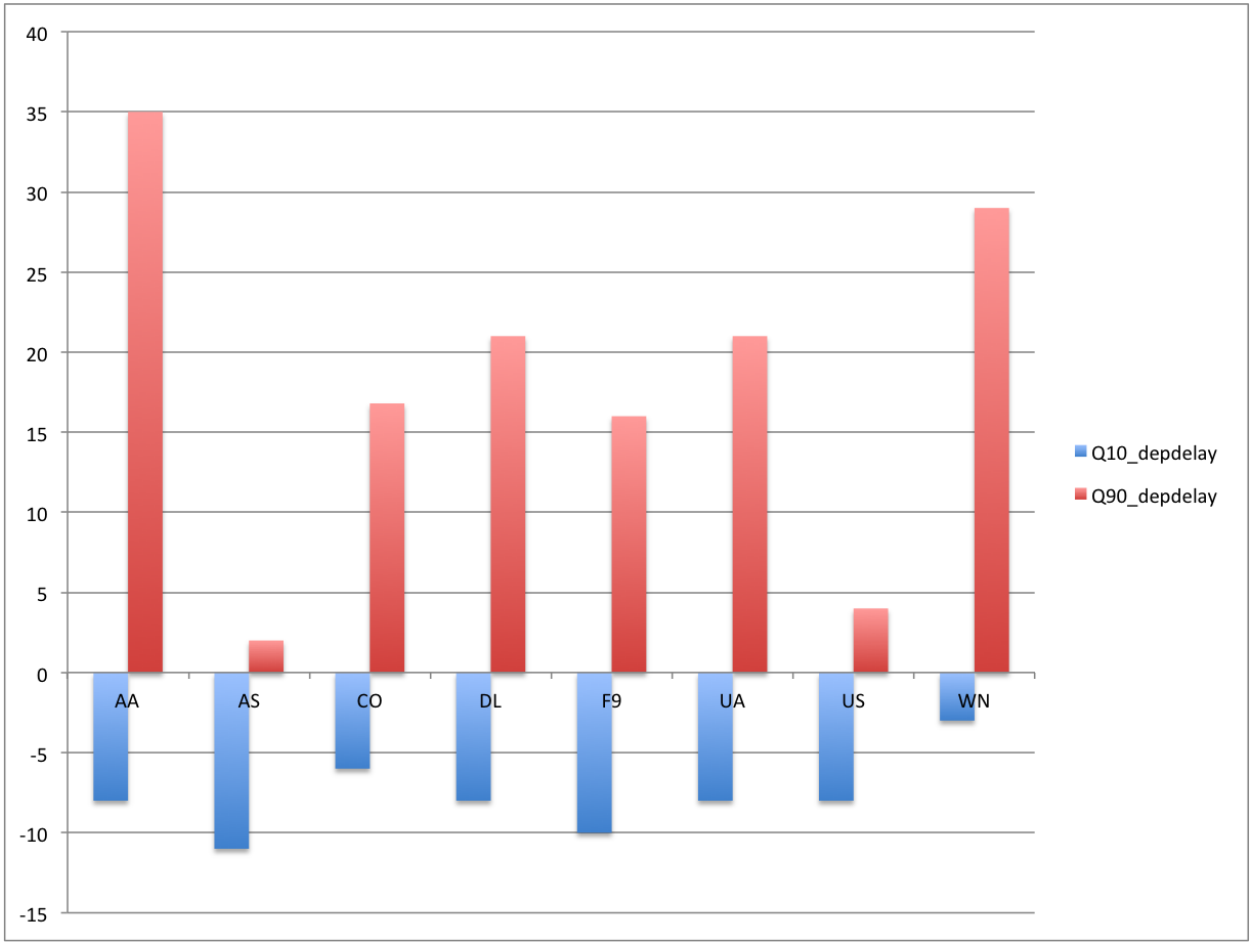

Figure: 10% and 90% quantiles of departure delays for all departure/arrival flights to/from SNA (2010:2).

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Model of price on delay (2010:2)

Linear regression of price on distance, fare class, carrier and departure delay

$$\begin{aligned}\widehat{PRICE_i} = {} & 1.10 \times 10^3 + 2.08 \times 10^{-1} DISTANCE_i - 1.05 \times 10^3 ECOCLASS_i \\ & - 5.16 \times 10^2 AS_i - 1.92 \times 10^2 CO_i - 1.63 \times 10^2 DL_i - 1.19 \times 10^2 F9_i \\ & + 3.09 \times 10 UA_i - 2.79 \times 10^2 US_i + 1.44 \times 10^2 WN_i \\ & - 4.56 Q90\_DEPDELAY_i \end{aligned} \quad (3)$$

Delay increases by one minute $\Rightarrow$ Price decreases by \$4.56.

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Baseline model

Influence of class, distance, competition, delay and time on price

$$\begin{aligned}\widehat{PRICE_i} = {} & 4.35.10^2 - 5.14.10^2 ECO_i + 3.88.10^{-1} DISTANCE_i \\ & + 1.71.10^2 COMPET_i - 1.23 Q90\_DEP\_DELAY_i \\ & - 2.62 TIME_i \end{aligned} \tag{4}$$

- Distance increases by 100 miles $\Rightarrow$ Price increases by \$39;
- Economy class $\Rightarrow$ Price decreases by \$514;
- Delay increases by one minute $\Rightarrow$ Price decreases by \$1.23.

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Other models to check the robustness of the baseline model:

- Price on constant, competition, distance, economy dummy, 90% quantile of delays, **time dummies**;
- Price on constant, competition, distance, economy dummy, 90% quantile of delays, time, **90% quantile of delays $\times$ time**;
- Price on constant, competition, distance, economy dummy, 90% quantile of delays, time, **carrier dummies**;
- Price on constant, competition, distance, economy dummy, 90% quantile of delays, **90% quantile of delays $\times$ time, time dummies, carrier dummies**.

$\Rightarrow$ Same quantitative results.

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The delays in a competitive market

Influence of competition on price

$$\begin{aligned}\widehat{PRICE_i} = {} & 7.69.10^{2} - 5.50.10^{2} ECO_i + 5.82.10^{-1} DISTANCE_i \\ & + 1.17.10^{1} COMPET_i - 4.57 Q90\_DEP\_DELAY_i \\ & + 4.63 Q90\_DEP\_DELAY * COMPET_i \\ & + \beta_k TIME\_k_i + \alpha_j CARRIER\_j_i, k = [2..47], j = [AS..WN] \end{aligned} \quad (5)$$

- Competitive market $\Rightarrow$ Price increases by \$12;
- Delay increases by one minute in a monopoly market $\Rightarrow$ Price decreases by \$4.57;
- Delay increases by one minute in a competitive market $\Rightarrow$ Price does not change.

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Variation of prices over time

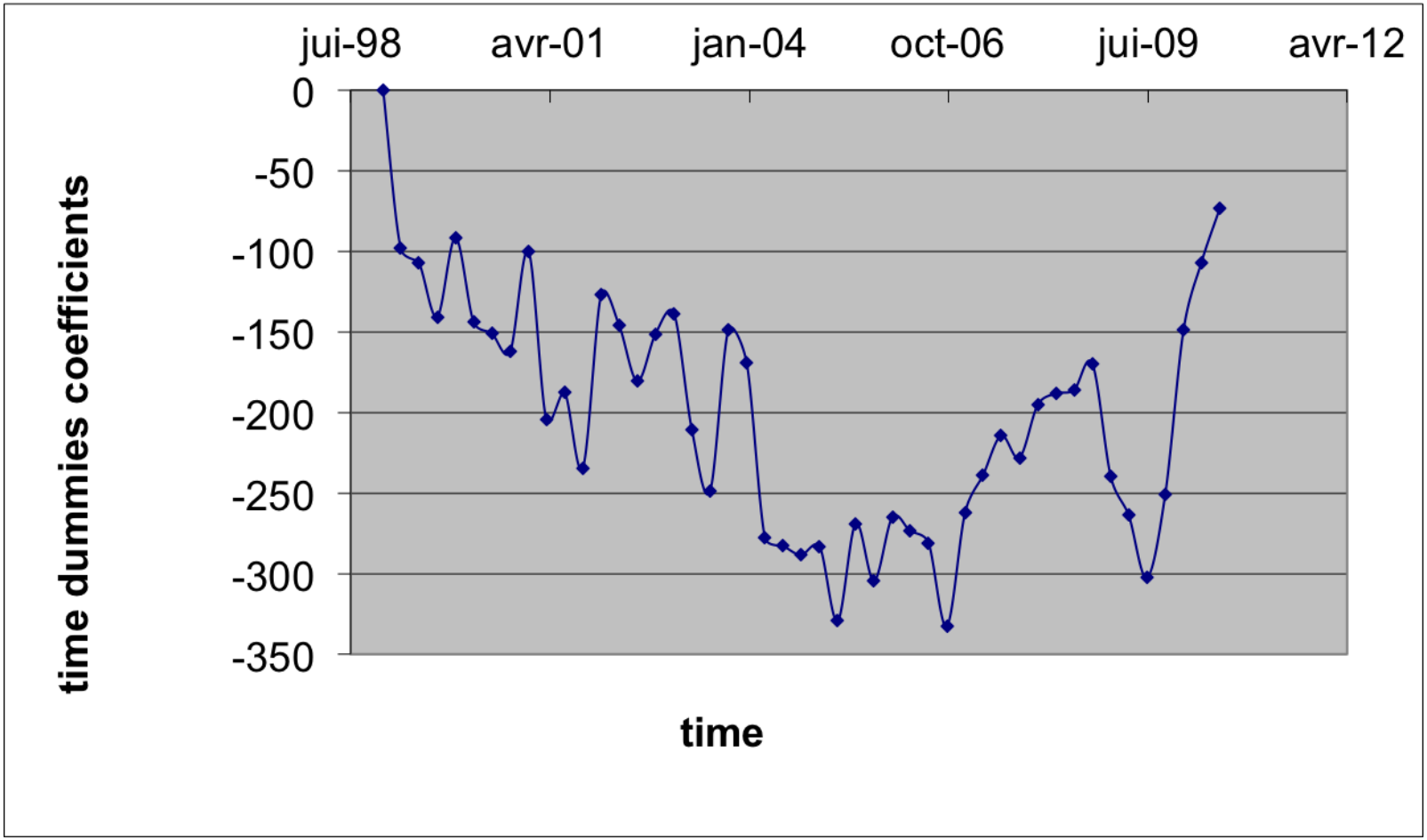

Figure: Quarterly time dummy coefficients from 1999 to 2010.

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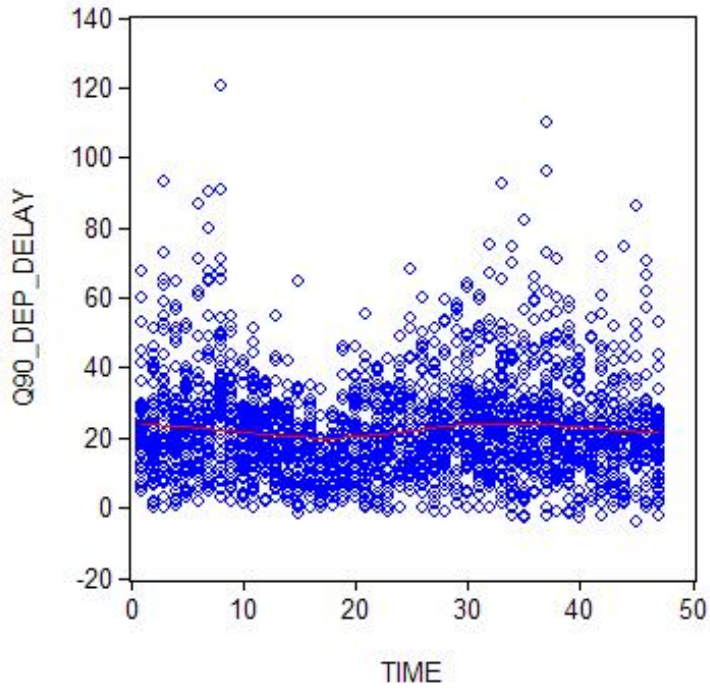
Delays over time through regulation



Quarters 17-20: year 2003

Amendment of the Settlement Agreement extensions on aircraft access $\Rightarrow$ increase of the maximum number of gates, flights per day, annual passengers.

Figure: Q90 of departure delays for each route and each quarter, from 1999 to 2010.

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Comparison with Forbes

Our study of SNA

- Delays increase by one minute $\Rightarrow$ Price increases by \$1.23;
- No delay effect in a competitive market;
- Tickets more expensive in a competitive market.

Forbes' study at LGA

- Delays increase by one minute $\Rightarrow$ Price increases by \$1.42;
- Bigger delay effect in a competitive market;
- Tickets less expensive in a competitive market.

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Going further

- Control for endogeneity;
- New terminal $\Rightarrow$ Bigger capacity $\Rightarrow$ Do the same study a few years later;
- Deeper study of the carriers and their on-time performance strategy.

IATA codes

Carriers:

- AA (American Airlines);
- AS (Alaska Airlines);
- CO (Continental Airlines);
- DL (Delta Airlines);
- F9 (Frontier Airlines);
- OO (SkyWest Airlines);
- UA (United Airlines);
- US (US Airways);
- WN (Southwest Airlines);
- YV (Mesa Airlines).

Airports:

- LGA (LaGuardia);
- SNA (John Wayne).