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Business and Economics

Using Pass-through Of Fuel Prices As A Proxy For Carbon Taxation Responses In The Aviation Industry

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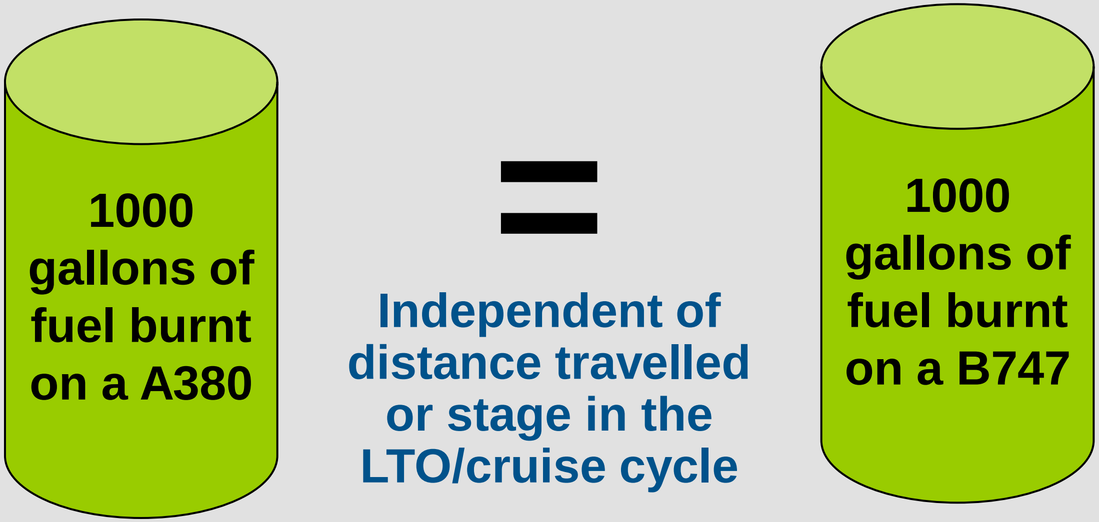
Objectives

1. **Present empirical estimates of cost pass-through for the aviation industry.**
2. **Establish empirical evidence of the relationship between firm specific characteristics and their ability to pass costs onto consumers.**

Increases in fuel prices are a suitable proxy to increases in carbon prices

- Carbon emissions directly proportional to fuel consumed: **airline's outlay on carbon varies is in step with its total fuel consumption**
- Effectively a direct tax on aviation fuel.



Emissions charges influence emissions in two broad ways

- **1. Supply side: Create marginal incentive to encourage the redistribution of productive resources to lower emissions from activities.**
- **2. Demand side: Increase the comparative cost of high emissions goods and thus discourage their consumption.**
- **Airlines have relatively fixed technologies in the short-medium term and hence demand side reactions are more relevant, On the supply side they “pay” other industries to reduce emissions.**

Cost Pass-through

Defined:

The proportion of a change in marginal costs that is passed through to a change in final goods prices.

In the aviation context:

What percentage of the increase in jet fuel prices have been passed on to travellers via increases in ticket prices?

- **Depends on**
  - Market Power (oligopolistic or monopolistic characteristics)
  - Firm aims (maximise profits, gain market share etc)
  - Nature of demand (elasticity)

  Full pass-through when the market is competitive or contestable
- **Literature:**
  - Incomplete, delayed exchange rate pass-through to prices of traded goods between countries (Engel, 1999; Parsley and Wei, 2001; Goldberg and Campa, 2006).
  - Asymmetric pass-through (Peltzman, 2000)

Importance of Pass-through in Aviation

- **Direct environmental effectiveness (closed system)**
- **Impact of policies on the aviation industry**
  - **Burden of policies**
    - > **Fixed technology**
    - > **Profits are modest over time – little scope to absorb cost increases**
    - > **Difference across business models (LCC, leisure carriers)**
    - > **Price increases will cause demand reduction**
- **Impact of policies on related industries**
  - **Intermediate good**
  - **Nonexistent empirical literature examining fuel price pass-through in the aviation industry.**
    - **ETS literature (EC, 2006; Ernst and Young, 2007; CE Delft, 2005; Oxera, 2003 etc)**

Data: Ticket Prices

- US DB1B (Origin Destination Survey): “10% continuous ticket sample of all passengers on all domestic flights in the U.S.”
- Quarterly
- Directional (origin known)
- Very large raw dataset
- 2.5 million observations per quarter across 50,000 route-airline combinations

Quantitative benefits

•Large but well bounded system
•No currency effects
•Small set of players
•Diversity of routes
•Homogenous data collection conventions across carriers and geographical areas
•Detailed data
•Mature market (conclusions valid for US)

Filtering

- **Domestic only**
- **Directional split (mark O&D M.ID)**
- **Remove**
  - $0 fares, fares less than $30 bulk fares, non-positive base fares, fares greater than $2500, fares with more than 6 coupons, bulkfares, non-contiguous travel...
- **Taxes (ATA, FAA)**
- **Fuel surcharges (Rickseaney.com)**

Ticket prices

(reasons for distributional irregularities)

- **Ticket prices are not a simple function of demand and supply**
  - Non homogenous products
  - Heterogeneous consumers
  - Price discrimination
  - Prices adjusted up till time of departure

COSTS → **Pricing Model** → **TICKET PRICES**

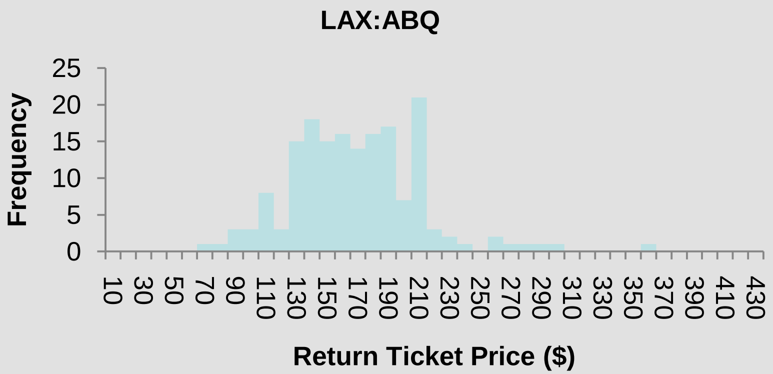
- **The average cost per hour of operating a specific aircraft type on a particular route is a constant factor.**

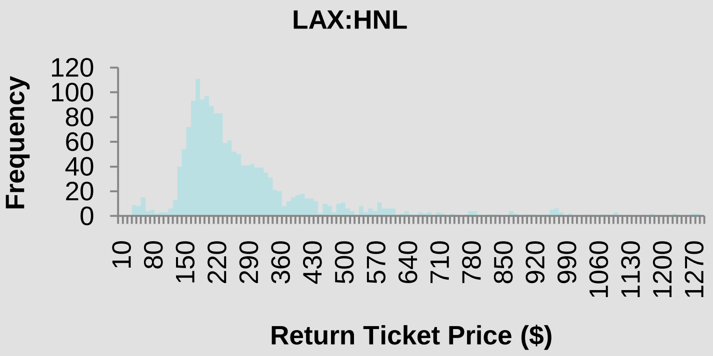
  (Airport landing fees, en-route air traffic control charges, fuel costs are approximately the same for all operators)

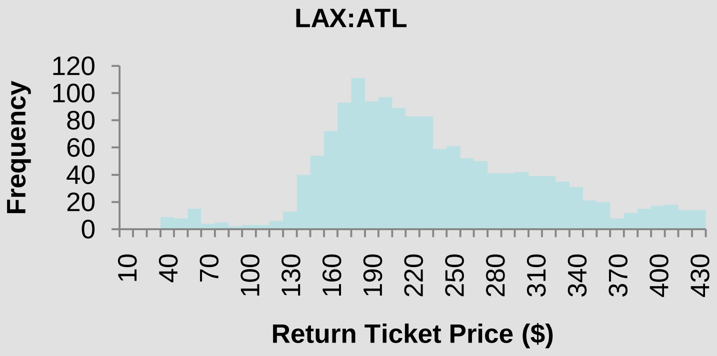
  On the whole, the average cost of flying an aircraft is given in advance of tickets being sold.
- **Ergo, a main source for differences in ticket prices is the airline's policy to fill its aircraft.**

Ticket prices

(distributional irregularities)







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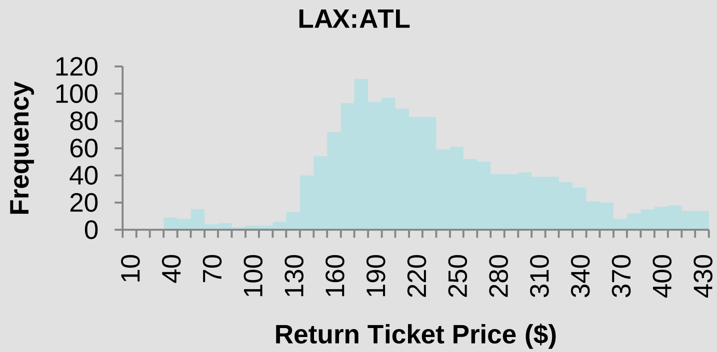
Ticket prices

(distributional irregularities)



<u>Point Estimates</u>

- **Mean, Mode, Median**

<u>How to get a point estimate?</u>

- **Truncated on left side**
- **Right Skewed**

Need to balance estimates

Also too many observations

<u>Options</u>

- **Leave**
- **Truncate on right side**
- **Non-parametric?**

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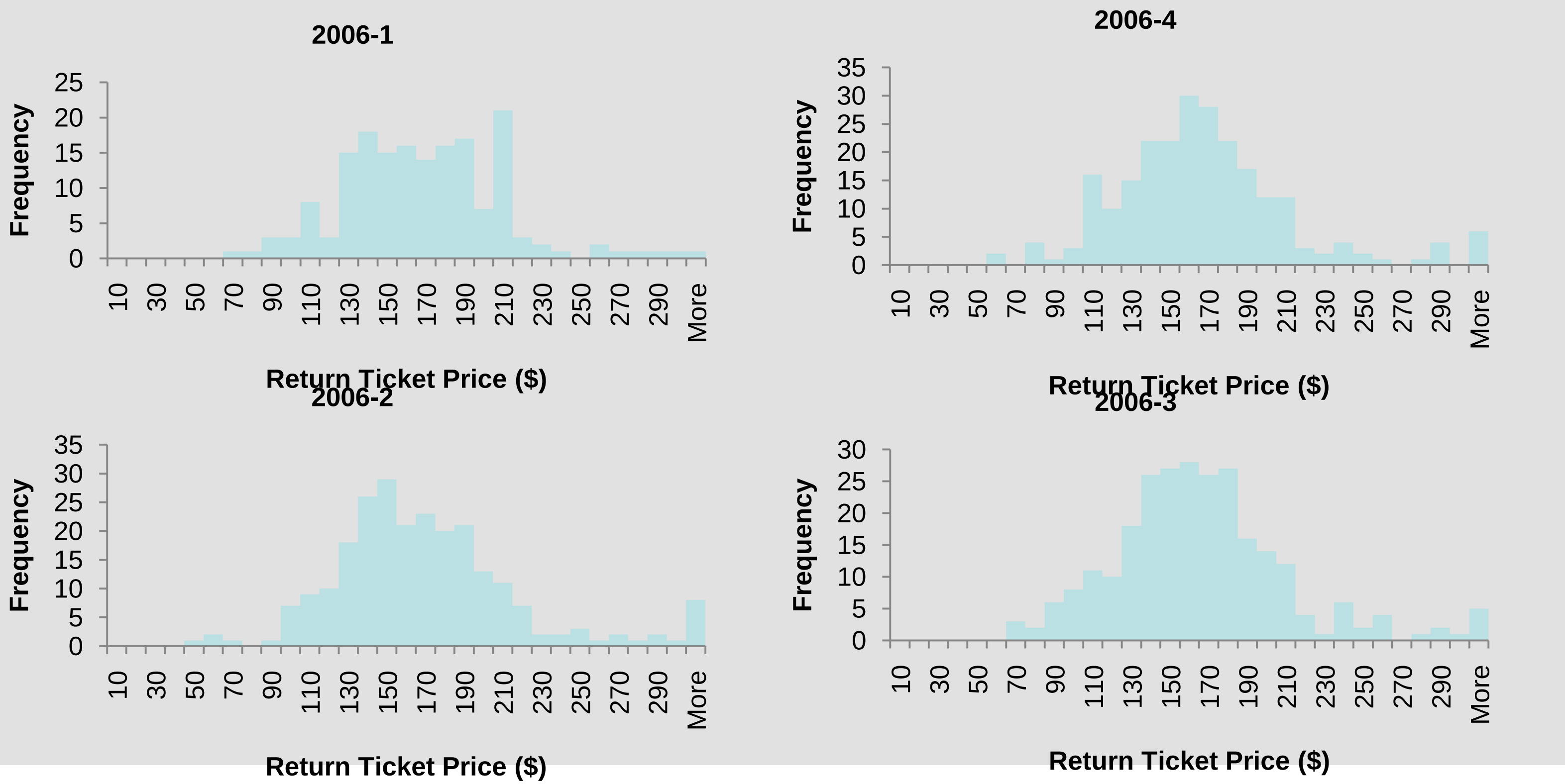
Ticket prices

(distributional regularities)

- **Route: LAX-ABQ 2006,1 – 2006,4**



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Aviation Fuel Price Trends

Aviation Fuel Trends

Characteristics

- **Comparable to crude oil prices**
  – Affected by crude oil demand
    > (winter -> heating oil etc)
- **Exponential rise**
  – 2000 onwards
  – Now peaked, (plateau?)
- **Prevalence of hedging**
  – Airline guarding against rising prices

•Assuming transaction costs are small in an economic model, firms' prices respond to marginal costs rather than accounting costs. While hedging contracts affect the firm's total costs, they do not affect its marginal costs. (Nakamura,2007)

•Oil prices tied in with economic variables (ticket prices and fuel prices determined jointly by economic conditions)

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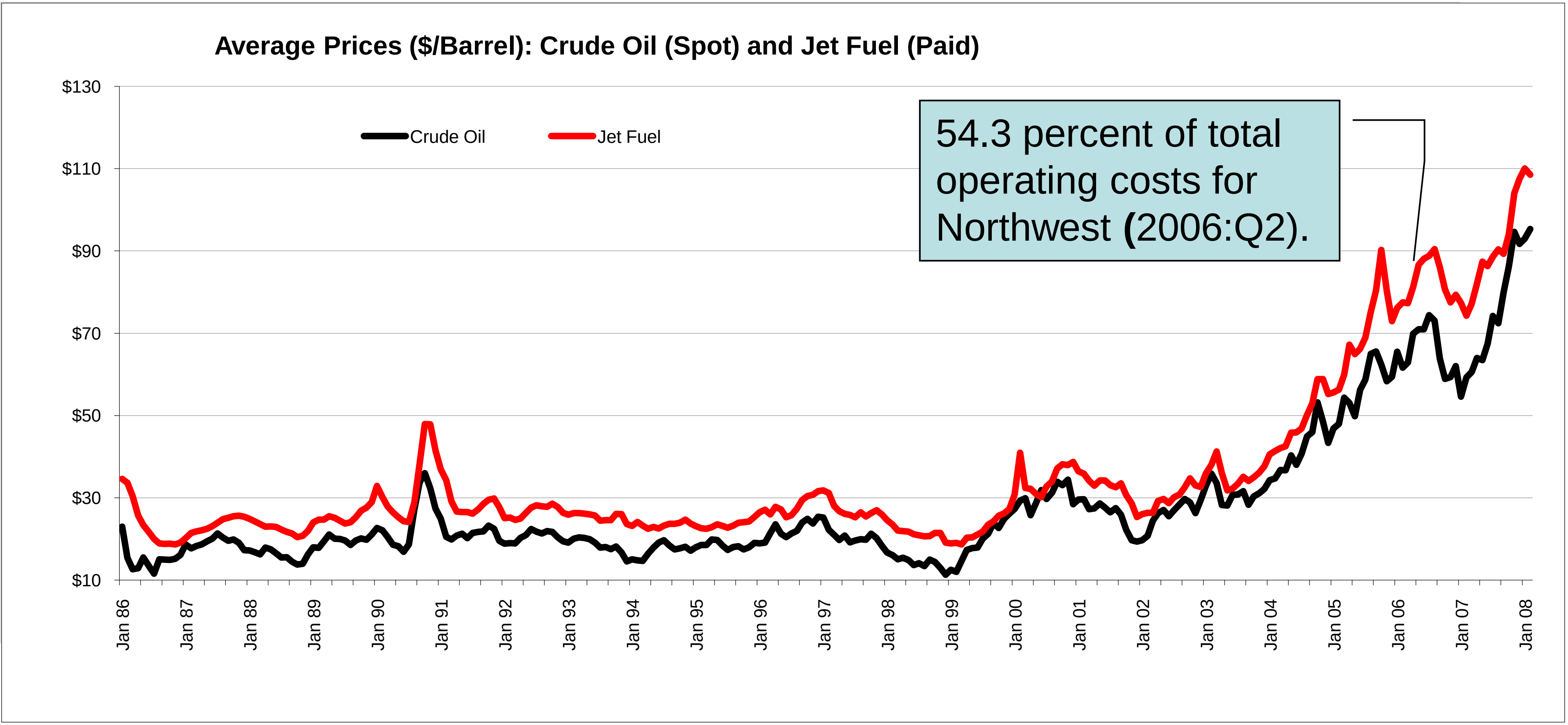
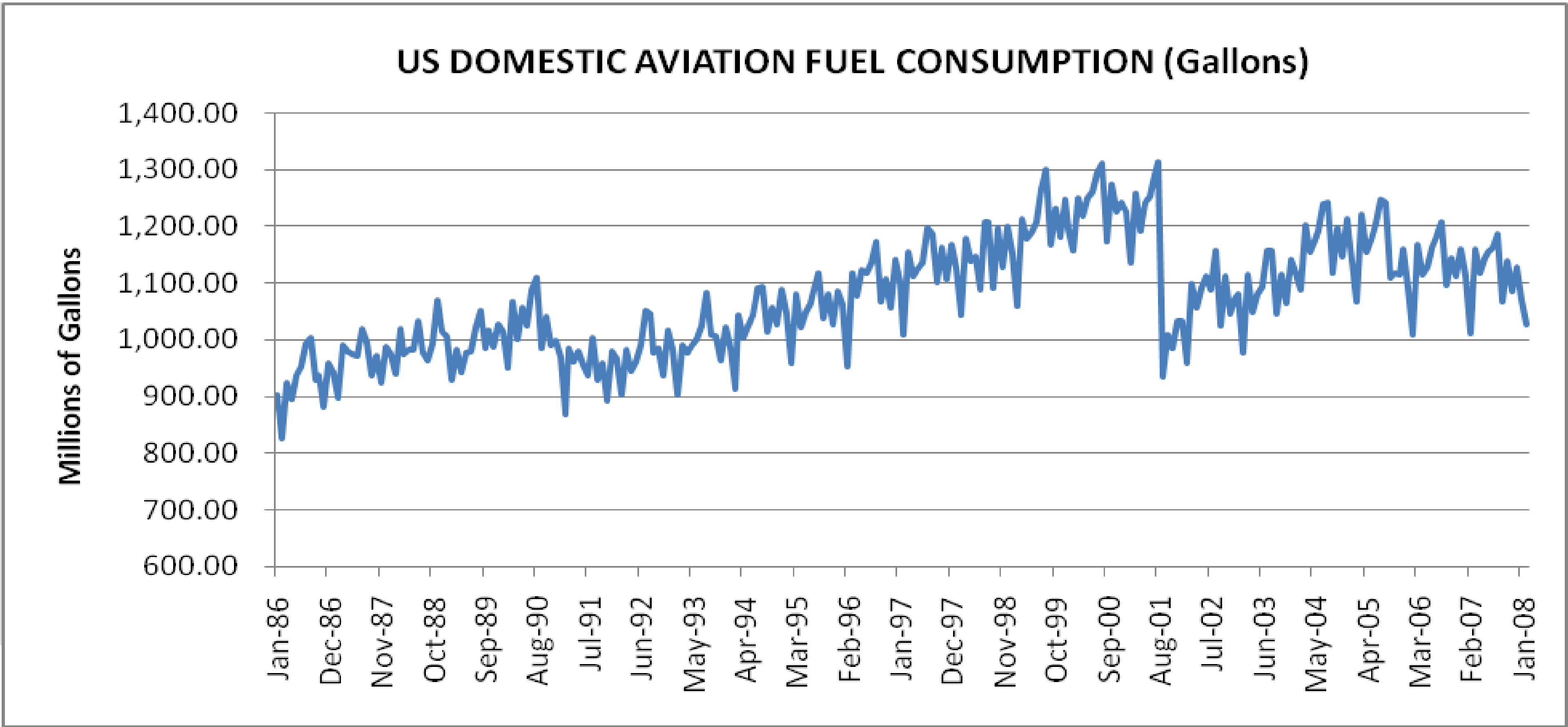
Aviation Fuel



Fuel Consumption



Trial Dataset

- **2028 U.S. airline routes**
- **17 carriers**
- **2000:Q4 to 2008:Q3.**
- **81,544 Observations**

Preliminary Empirical Model

- **Standard pass-through regression (Goldberg and Campa, 2006),**

$$\Delta log p_{jmt} = \sum_{k=0}^{6} \beta_k \Delta log F_{t-k} + \sum_{k=1}^{4} \delta_k q_k + \epsilon$$

- ***p* is the ticket price for carrier *j* operating on route *m*, *F* is the fuel cost, *q* is the quarter of the year dummy**

- **In the log-form, the coefficients may be interpreted as the percentage change in prices associated with a given percentage change in fuel costs *k* quarters ago. The sum of the coefficients for the different lags can be interpreted as the long-term effect of a cost shock.**

Preliminary Empirical Model

- **We consider two measure of cost**
- **1. Actual ticket price**
- **2. Ticket price per market mile travelled.**
  - The number of lags in the regressions were selected such that adding the additional lags did not affect the long run rate of pass-through.

Preliminary results:

•Long-run pass-through of 4.7% increase for ticket prices and 3.5% increase for market mile ticket prices in response to a 1% increase in fuel prices (so between 350% and 470%).

•Fixed effects 110%-167%

Explaining the impact

- A priori, expected the percentage pass-through to be less than complete since other intermediate inputs besides fuel drive a wedge between fuel costs and final ticket prices.

- Cautious outlook
- Exogenous (US)
- Increase information asymmetry from fuel surcharges

Fuel surcharges and asymmetric information

- **Fuel surcharges as a new and widespread phenomenon created an environment where the final price of tickets were not easily accessible.**
- **Fuel surcharges cannot be perceived to be the full pass-through of the airline’s fuel costs. In fact, the value of the fuel surcharge is somewhat arbitrary. There is also no legal standard to determine what portion of ticket should be formed as taxes.**
- **Like other taxes, separate from the headline price.**
- **The full cost of the ticket isn’t fully disclosed to the passenger until near the end of the transaction.**
- **Information cost**

Asymmetric Cost Adjustment

- **Asymmetric link between crude oil and gasoline prices (Geweke, 2004).**
- **Borenstein et al (1997) three explanations (for gasoline market) including a model of consumer search cost.**

Asymmetric Cost Adjustment

- **Test for this type of asymmetry:**

$$\Delta logp_{jmt} = \beta_i^{+} \Delta logF_{t-k}{}^{+} + \beta_i^{-} \Delta logF_{t-k}{}^{-} + \sum_{k=1}^{6} \beta_k \Delta logF_{t-k} + \sum_{k=1}^{4} \delta_k q_k + \epsilon$$

- **These regressions are inconclusive on the issue of asymmetric price adjustment. The log-ticket price regression shows some evidence of strong asymmetric cost adjustment favouring negative fuel shock while the log-market mile ticket price regressions favoured positive fuel shocks.**

(VERY!) Preliminary Conclusions

- Airlines, across a weighted average of existing market structures, can pass the full cost of emissions (fuel) charges (or more) on to consumers.
- No evidence for asymmetric pass-through

Fixed effects model

- **Fixed effects panel model log-differenced Ticket Prices against log-differenced fuel prices stratified by airline/route combinations.**
- **Some variables to include**
  - Competition (HHI)
  - Flight frequency
  - Load factor
  - Aircraft type
  - Network properties (Hub)
  - Fuel efficiency
  - Route characteristics (Leisure/Business, travel time)
  - OD Characteristics
  - Airport efficiency (cancellations)

$$\ln(\Delta \text{Ticket Price}_{\substack{\text{Time}\\ \text{Carrier}\\ \text{Route}}}) = f\left(\ln\left(\Delta \text{Fuel Price}_t\right), X\right)$$

$$y_{rct} = \alpha_r + \gamma_c + \sum_{k=1}^{K} \beta_k X_k + \varepsilon_t$$

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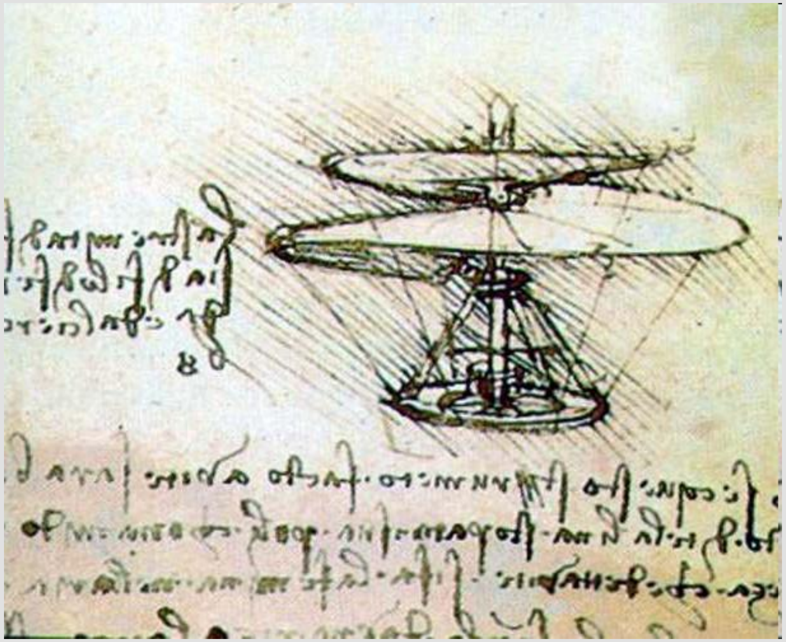
THAN K YOU!

Any QUESTIONS?



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