Input Technology and Airline Pricing

DSE Conference

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Motivation

Linking shocks in the supply to consumer welfare and market outcomes is fundamental to correctly anticipate the effect and the cost and benefits of regulations, supply chain disruptions.

Primary Question: What is the rate of cost pass-through in the short term (1 year horizon)? and what are the pass-through differences

- across markets (the shock has different impacts)

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- across markets (the shock has different impacts)
- within markets (between firms)
- between consumers (high vs. low type)

Secondary Questions

1. How do firms cope with shocks to their capital assets?
2. How is market concentration affected by cost shocks?
3. How does competition relate to pass-through? (work in progress)
4. What is the environmental gains from more fuel efficient technology? (work in progress)

Literature Review

- Pass-through literature: Fabra and Reguant (2014) full pass-through in electricity markets; Genakos and Pagliero (2021) full pass - through in competitive markets ($>$3 competitors) whereas 0.4 in monopoly markets.
- Airlines Reduced form fare analysis: Chandra and Lederman (2018)
- Product Differentiation Structural Models
  - General: Steven T. Berry (1992), Steven T. Berry (1994), Goldberg (1995), Nevo (2001), Grigolon and Verboven (2014)
  - Applied to Airlines: S. Berry and Jia (2010), Marra (2021), Gualdani, Bontemps, and Remmy. (2022), Aryal, Murry, and Williams (2018)
  - Applied to other industries: Dubois and Lasio (2018)

Setting

Cost shock details. Unexpected (thus exogenous) supply shock in the US airline industry:

Figure 1: Boeing 737Max


Southwest
Southwest
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- Who...
  - enforced it: US Federal Aviation Administration (FAA)
  - was affected: routes in which Southwest (LCC), United (legacy) and American (legacy) operated using 737Max aircrafts.

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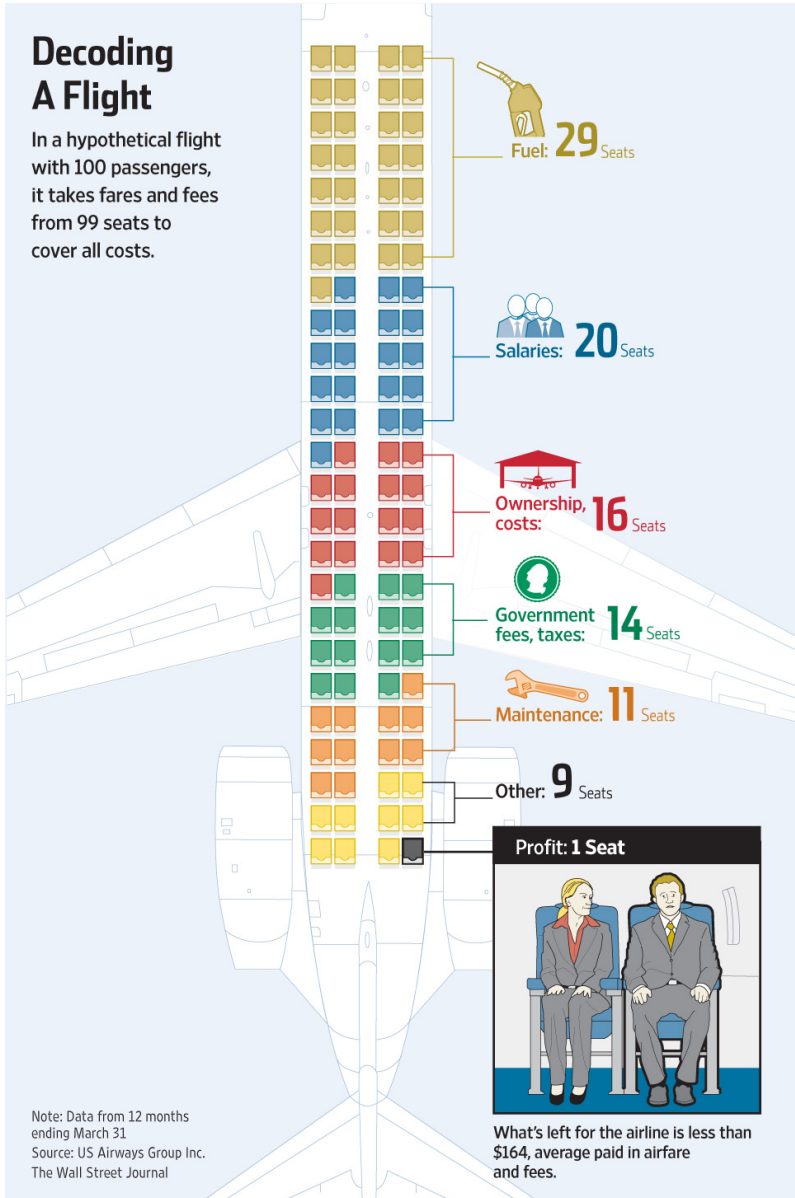

Figure 2: Fuel is a main component of a ticket price

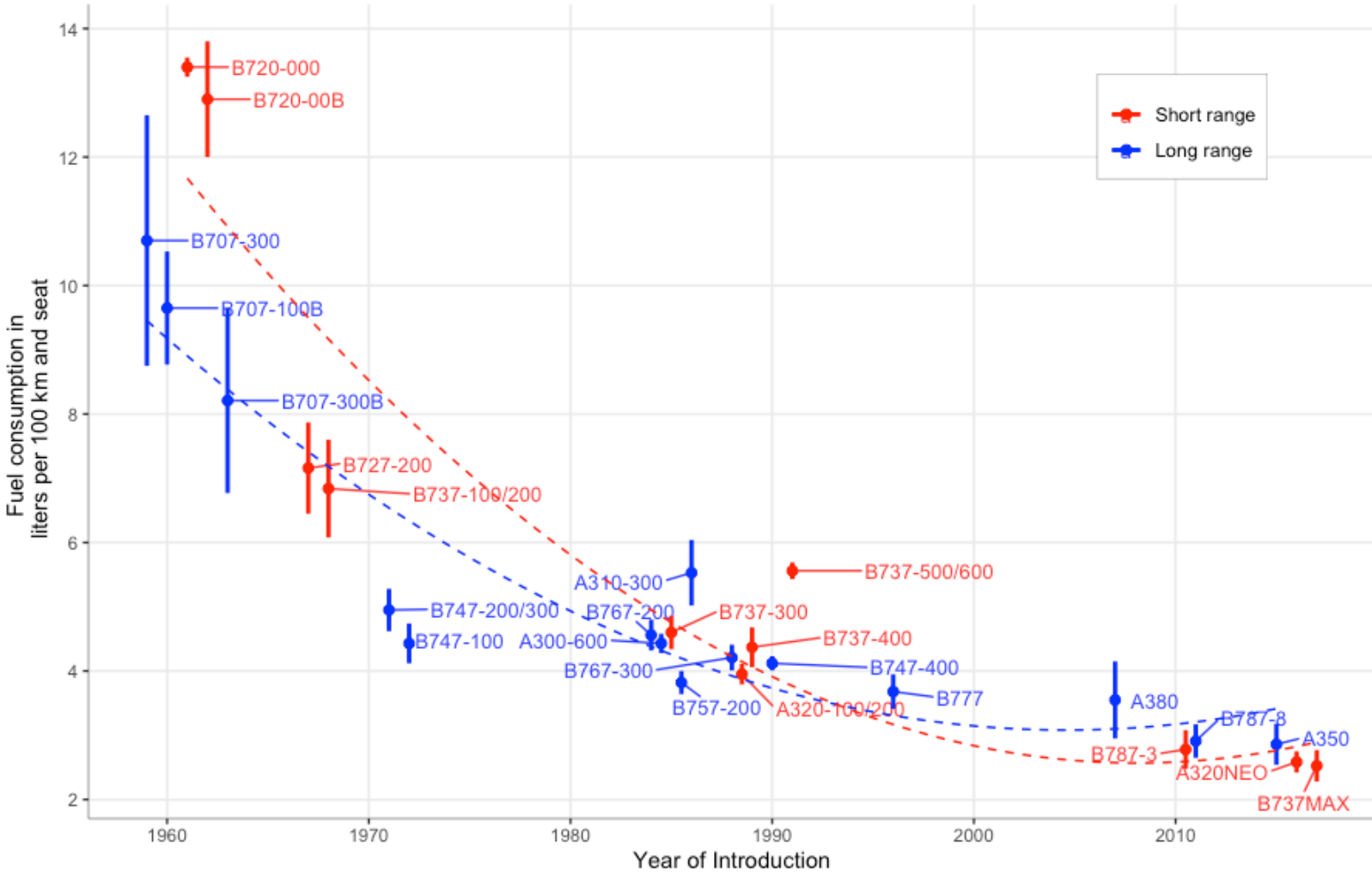

Figure 3: Aircraft fuel consumption has been decreasing, since 1960

Cost Shock Impact Determinants

Cost of replacing a B737Max aircraft:

- fuel efficiency of the aircraft used for replacement (before ban, Q4 2018*)
- adjustment cost of switching aircraft model (other than fuel, e.g. administrative, retraining pilots)
- cost of aircraft storage until allowed to fly again if ever, (unknown at the time... spoiler: the ban was lifted at the end of 2020)

[*] B737Max of each airline: United had 10 (1002, 10%); American, 20 (from 1223, 16%); Southwest, 30 (from 732, 18%)

Data

- Domestic market in the US
- 2018 and 2019 (no 2020 due to Covid), fares $>$ \$20 and domestic only
- Flights from/to airports within same MSA or 25-mile radius aggregated (e.g. Chicago ORD and MDW airports)
- 11 carriers: Alaska, Delta, JetBlue, Spirit, Hawaiian, Frontier, Alegiant, Sun Country, **American**, **Southwest**, **United.**
- 18% (relative to the $\sim$ 6000 routes in 2018) had Boeing 737 operating in 2018 (any quarter) = **Treated routes** (TM)

Sources

1. Fares (per class, O-D, quarter-year, carrier):
   - from DoT DB1B database (10% random sample)
   - 2 classes: business and economy
2. Aircraft and flights:

- Open Sky Network: observe the **whole** market: the carrier, time, fleet, route combination for all flights —> more accurate market shares (novelty)
- Aircraft Registry: track aircraft fleet movements/changes, using a registration number and for domestic flights (novelty)
- T-100 Domestic Segment database: to impute route level load factors (passengers travelling wrt to the carrier's available seat capacity)

Reduced Form DiD

- Level of observation: m is a market, t is year-quarter, and c is the carrier
- Outcome: Log Fares (P^b_{mtc})
  - b: economy and business class (separately analysed)
- Time (t): before and after ($PostBan$) the aircraft model ban
- Treatment group ($D = 1$): routes in which a 737Max aircraft had been operated in the past year

$$P^b_{mtc} = \beta^b_0 + \beta^b_1 D_m \times PostBan_t + \beta^b_2 X_{mtc} + \lambda^b_m + \theta^b_t + \mu^b_c + \epsilon^b_{mtc}$$

PostBan indicates post ban period, from Q1 2019

β_1 is the treatment effect

DiD treatment and control groups

- Similarities between treatment and control groups
- Similar in prices, distance, hub routes, tourist destination and income.
- Differences in the number of competitors.
  - Mean: 3.5 (2 LCC) in affected markets vs. 2 (1 LCC) in the rest.
  - Sd: varies substantially within markets, ~50% variation wrt the mean, so there is overlap, 1.5 in TM vs. 1.2 in the others)

Effect of the ban on other market outcomes (Proof change dependent variable in DiD regression)

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1. The ban did *not* affect (i) willingness to fly of passengers (DiD with nb of passengers as dependent variable) (ii) load factors
2. Ban did increase market concentration: (i) HHI increases, (ii) the % LCC decreases (driven by Southwest)

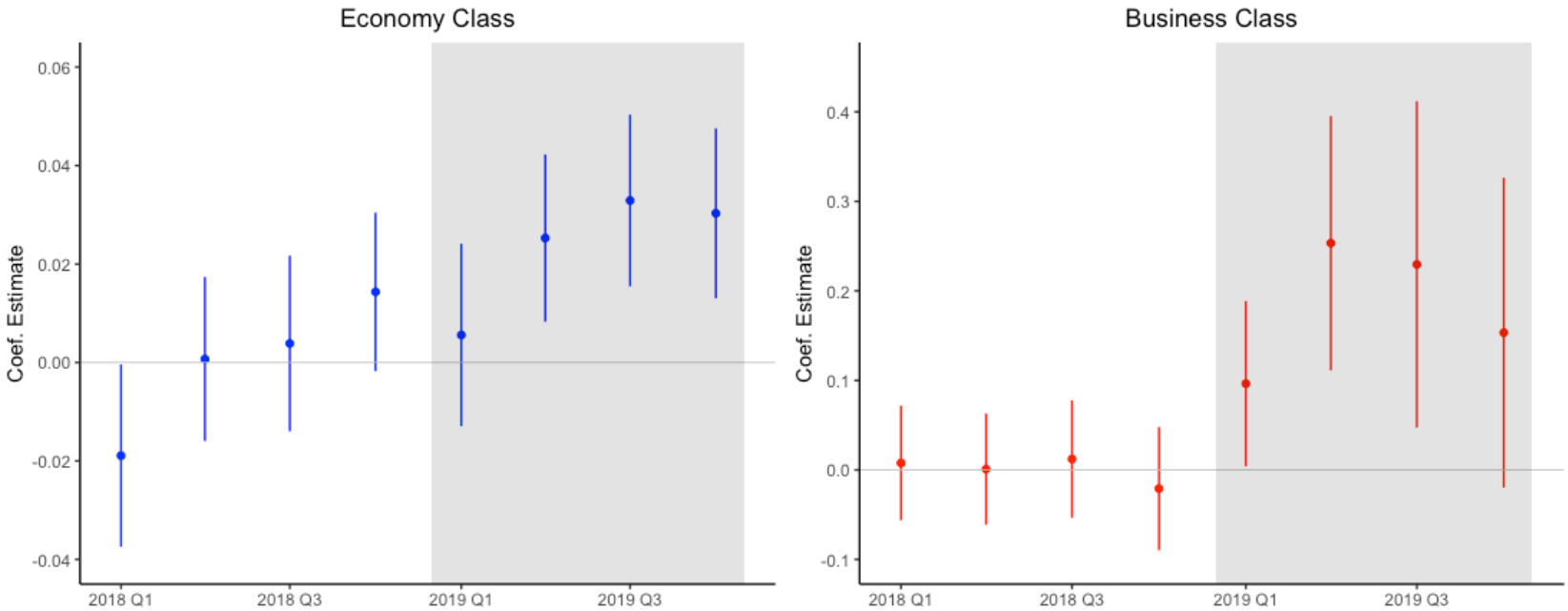

Figure 4: Differences in Prices Between Treatment and Control

Adjustment Process

Possible adjustment channels (for firms with affected fleet):

1. **Use existing idle capacity** (more intensive usage of other aircraft models)

Ruled out channels:

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- 5: reduced flight frequency not observed in affected markets (wrt the unaffected) but there is a decrease in the market share of Southwest towards unaffected carriers (American and United are unaffected)

Adjustment Process

Results from the data

We observe:

- increase in the general usage of Boeing 737 aircraft, and also the Airbus 320 Family (neither is very fuel efficient)
  - lower fuel efficiency (B737 consumes 2.28 liters per 100km per seat, A320 – 2.61, B737 – 3) so 14% increase to replace to an A320, whereas 32% to use a B737

Conclusion: The ban of a model (reduction in the available capacity) represented a marginal cost increase.

Note that it is not easy to substitute across manufacturers (ex. transition from Boeing to Airbus): requires retraining pilots, different maintenance, etc.

Results

Economy class fares increased 2.6%, whereas Business class it was 15.5%

Dependent Variable:	Log(Mean Fare)					
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
Treated Market × PostBan	0.017**	0.025***	0.026***	0.131**	0.138**	0.155**
	(0.008)	(0.004)	(0.004)	(0.066)	(0.062)	(0.073)
Treated Market		0.818				
		(7,688.5)				
Fixed-effects						
Market FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Carrier FE		Yes	Yes		Yes	Yes
Market x Carrier FE			Yes			Yes
Fit statistics						
Observations	27,424	27,424	27,424	2,674	2,674	2,674
Adjusted R^2	0.38310	0.90258	0.94179	0.25251	0.50939	0.52823
Pseudo R^2	0.38962	1.6926	2.1989	0.16992	0.35702	0.47008

Clustered (Market FE) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

(1-3) Economy, (4-6) Business,

Analysis and Additional Results

- Economy. Average effect on the average fare: 2.6% of 221 = \$5.7
- Business. Average effect on the average fare: 15.5% of 512 = \$79
- In treated markets, treated carriers were affected more:
  - 1.7% from treated market and
  - 1.9% additional effect on affected carriers
- Persistent effect: event study, interact treatment with quarter.
  - Significant for the 3 Quarters after the ban

Conclusion

- The ban lead to an increase in economy (2.6%) and business fares (15.5%) in treated markets.
- Effect is persistent.
- Within treated markets the affected carriers had an extra 2% (cost pass-through) wrt the 1.7% that ocurred in the treated routes.
- Market concentration increases after the ban.
- Next steps:
  - increase in fuel consumption by carrier,
  - check treatment effect conditional on route distance,
  - non parametric treatment effect (matching by competition).

Event Study

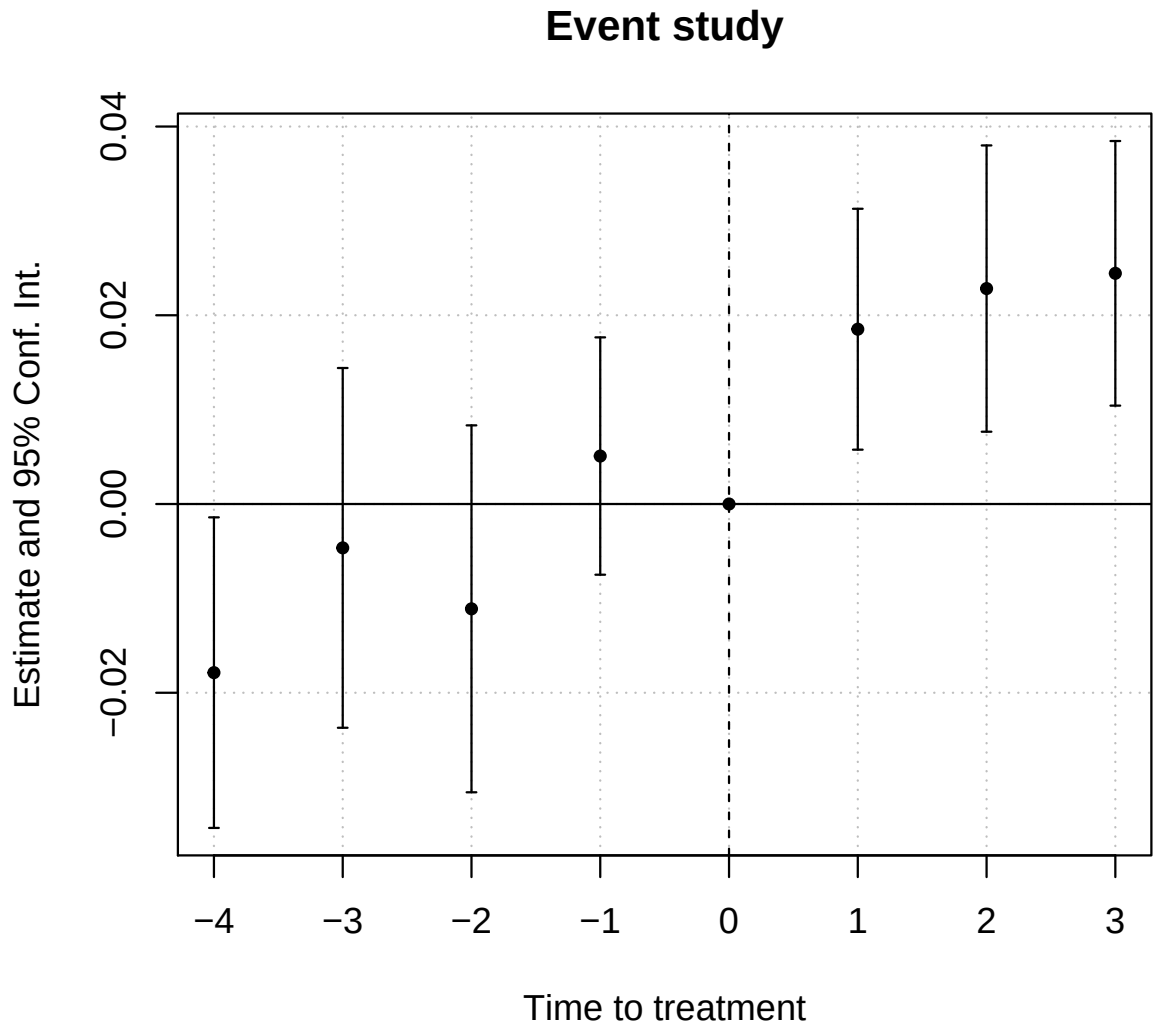

Figure 5: The effect of the shock is persistent. Time 0 is Q1 2019 (includes 15 days of treatment).

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