Carbon pricing for transport: The case of US airlines

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Based on ongoing joint work with Felix Grey
Overview of this talk

① Update on climate policy for the transport sector, particularly for aviation (and shipping)

② Economic theory for large-scale estimation of profitability impacts of carbon pricing

③ Estimates of ‘carbon cost pass-through’ for US airlines and implications for fuel demand
Climate policy for transport: Aviation

Aviation is growing fast & hard to decarbonize
— CO₂ emissions = 2.5% of global total (5% by impact)
— Set to triple by 2050 without new policies

Climate policy for aviation is starting to pick up...

1. **EU ETS** since 2012 ($5/tCO₂)
2. China regional **ETTs** ($1/tCO₂)
3. **2016 International agreement** (ICAO)
   — Global market-based policy from 2021
   — Emissions offset system

Similar policy dynamic for shipping industry
How does carbon pricing affect firms?

Who cares?

1. Regulated firms
2. Policymakers
3. Institutional investors + Mark Carney

‘Simple’ market structure in ‘early adopter’ sectors
— Electricity, aluminium, steel, etc.
— Small no. of markets; homogenous products

Airline industry is much more complex
— Many routes; differentiated-products competition
— Existing models become difficult to implement
Factors affecting the impacts of carbon pricing

What does the profit impact for firm A depend on?

- Firm A’s production technology (abatement)
- Demand for firm A’s (differentiated) product
- Competitiveness of the market

... and also characteristics of firm A’s rivals:

- Completeness of regulation (cost changes)
- Production technologies (abatement)
- Product-market strategies

⇒ Our approach radically simplifies this problem
New economic theory of profit impacts

“General linear model of competition” (GLM)  
— From the viewpoint of a (single) firm A

Key assumptions about firm A:  
1. Chooses its emissions intensity optimally  
   (given the carbon price)  
2. Follows a linear product market strategy  
   — Many well-known models of imperfect  
     competition are nested as special cases  
     — Static, dynamic, ‘behavioural’

NB. No assumptions about the demand structure or  
about firm A’s rivals (technology, strategy, etc.)
Main result from the theory

Profit impact \approx 2 \times (\text{firm A's cost pass-through} - 1) \times \text{carbon price} \times \text{firm A's historical emissions}

\Rightarrow \text{Cost pass-through as a “sufficient statistic”}

- Captures \textit{all} relevant information about firms’ technologies (abatement) & strategies, customer demand patterns etc.

Implications:
1. Higher pass-through improves profit impact
2. Profits rise if pass-through exceeds 100%
Data on US airline industry

US airline industry
— World’s largest market with 30% of global emissions
  — Emissions: $172mtCO_2 = $8.6bn (at $50/tCO_2)
  — Profits (2015): $7.5bn

Key features of dataset
Product = Carrier-route, over time, average ticket price
— 10% sample of all airline tickets sold
  — Exclude frequent fliers, non-economy tickets, outliers, tiny airlines
  — Construct per-passenger fuel costs

⇒ 669 carrier-routes over 44 quarters (2002-2012)
Airlines’ fuel costs have been very volatile

Figure: Average per-passenger fuel cost $k_t$ and the spot price of jet fuel.

Felix Grey and Robert Ritz
Carbon pricing and firm profits
13 June 2017 17 / 32
Estimates for Southwest on LAX-SLC route

Pass-through
= 109-115%
— Profits ↑
— Jet fuel demand ↑
— CO₂ ↑
⇒ Carbon pricing good for Southwest

Notes: Pass-through after 4 quarters. Controls for GDP growth, non-fuel costs, number of competitors, seasonality. Instruments for endogeneity of per-passenger fuel costs.
Heterogeneity in profit impacts of carbon pricing

<table>
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<th>Southwest</th>
<th>Legacy carriers</th>
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<tbody>
<tr>
<td>Average carbon cost pass-through</td>
<td>135%</td>
<td>41%</td>
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<tr>
<td>Total profit impact ($50/tCO₂)</td>
<td>+$0.3bn</td>
<td>−$4.0bn</td>
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Profits of legacy carriers are **almost wiped out**, across the routes in our dataset, by $50/tCO₂ (American, Delta, United, US Airways).
What explains differences in pass-through?

1. **Route portfolio (~60%)**
   - Southwest flies shorter routes than legacy carriers
   - Shorter routes have higher carbon cost pass-through (*why?*)

2. **Fuel efficiency (~20%)**
   - Southwest is more fuel-efficient
   - Mostly due to flying newer aircraft

3. **Demand factors (~20%)**
   - Southwest tends to have lower ticket prices & larger market share than legacy carriers
   - Customers perceive product differences
Conclusions

① Carbon pricing for transport increasingly likely in key jurisdictions from 2020s onwards

② Competition in airlines and shipping is more complex than in existing carbon-regulated sectors

③ New theory allows large-scale quantification of impacts using (only) estimated pass-through rates

④ Airline profit impacts likely very heterogeneous
   — Winners & losers can be anticipated
   — Implications for fuel demand & emissions
This talk is mostly based on a forthcoming paper:


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