Carbon pricing for transport: The case of US airlines

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EPRG-CEEPR-Enedis International Conference
Paris, 7 July 2017

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

— CO_2 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 ($5/t$CO_2$)
2. **China regional ETSs** ($1/t$CO_2$)
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 ≈ 2 x (firm A's cost pass-through – 1)
x carbon price
x firm A's historical emissions

⇒ **Cost pass-through as a "sufficient statistic"**
— Captures *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

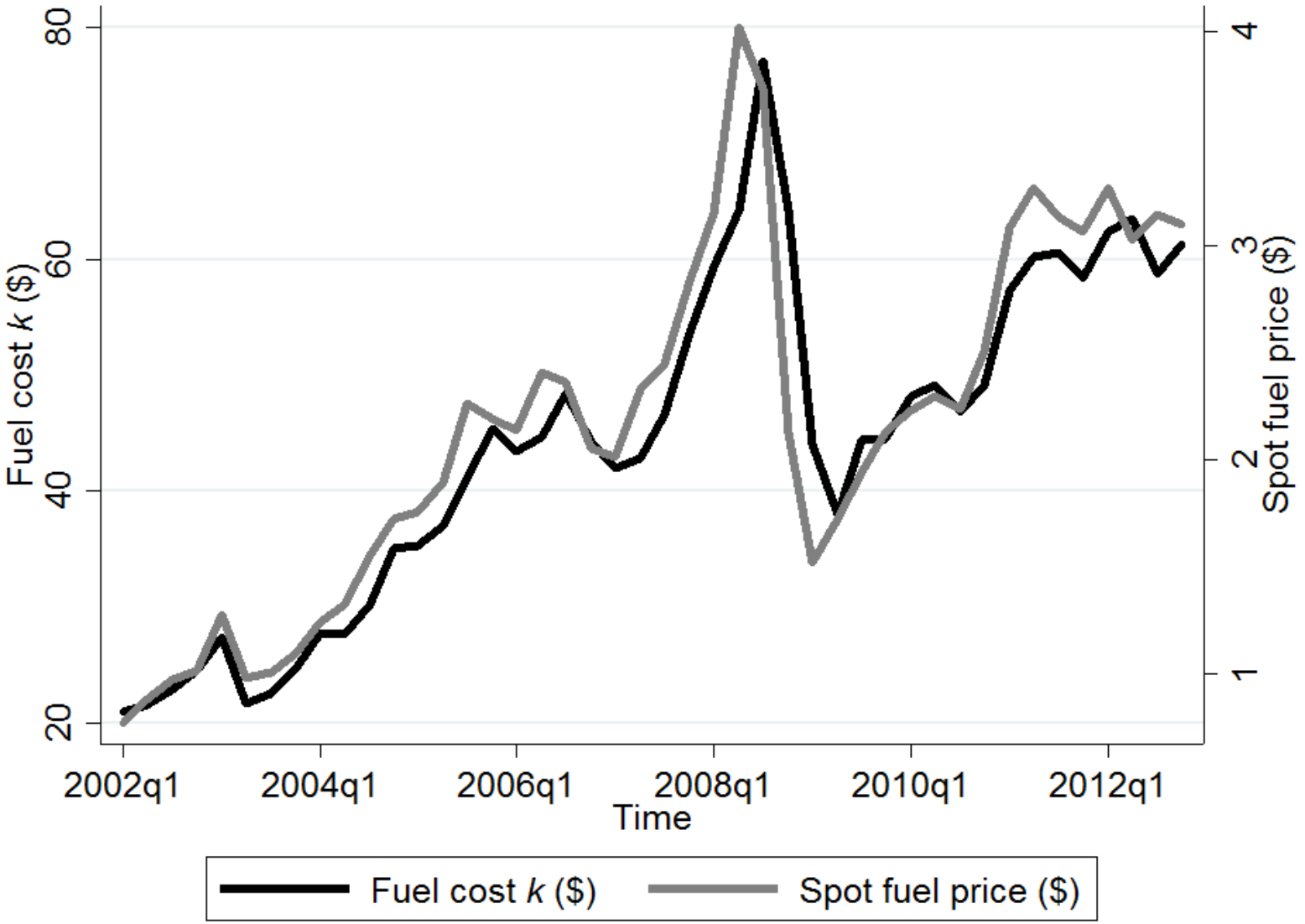
— World's largest market with 30% of global emissions
  — *Emissions*: 172mtCO_2 = \$8.6bn (at \$50/tCO_2)
  — *Profits* (2015): \$7.5bn

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



Estimates for Southwest on LAX-SLC route

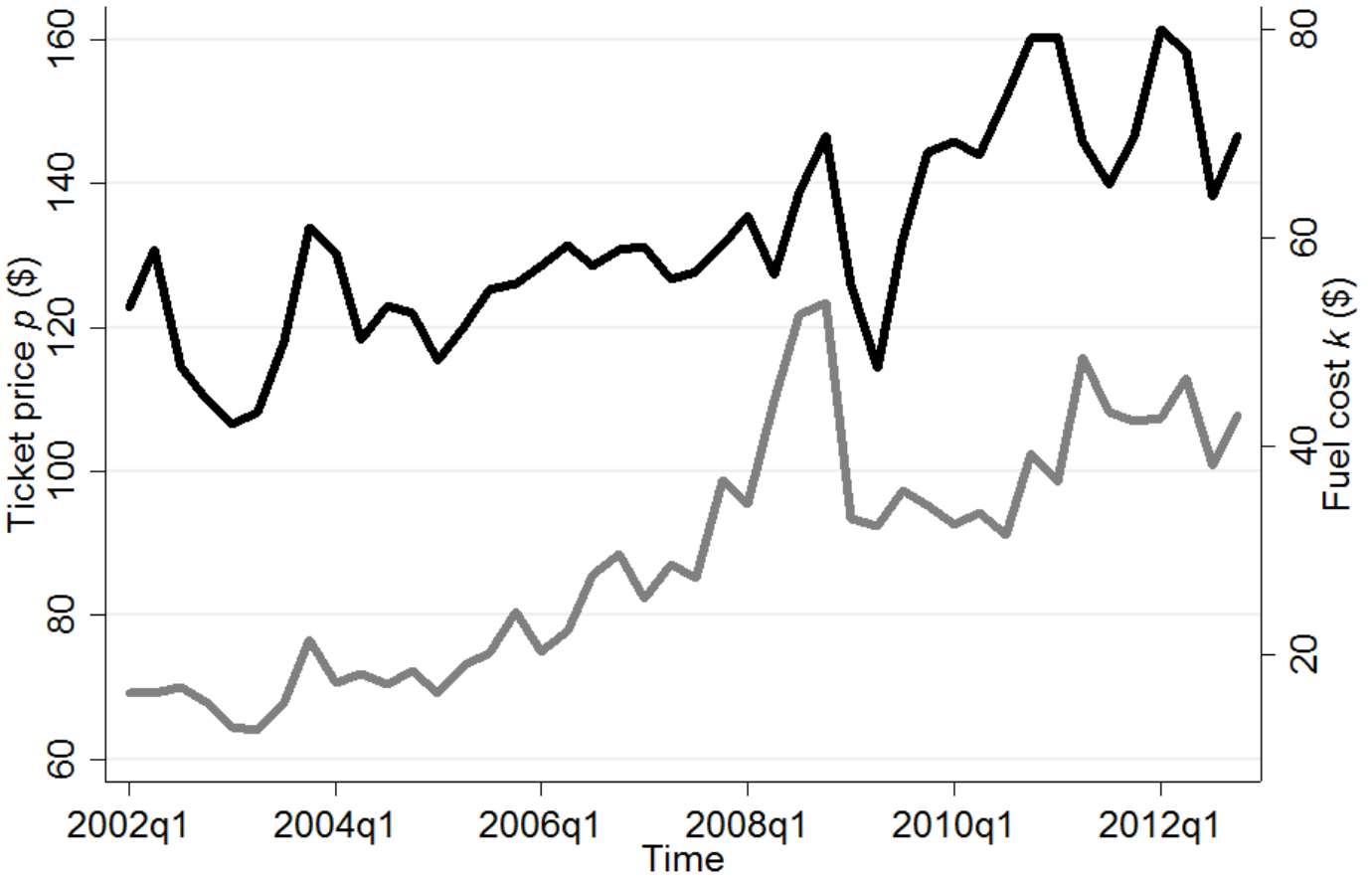
Pass-through = 109-115%

— Profits ↑

— Jet fuel demand ↑

— CO_2 ↑

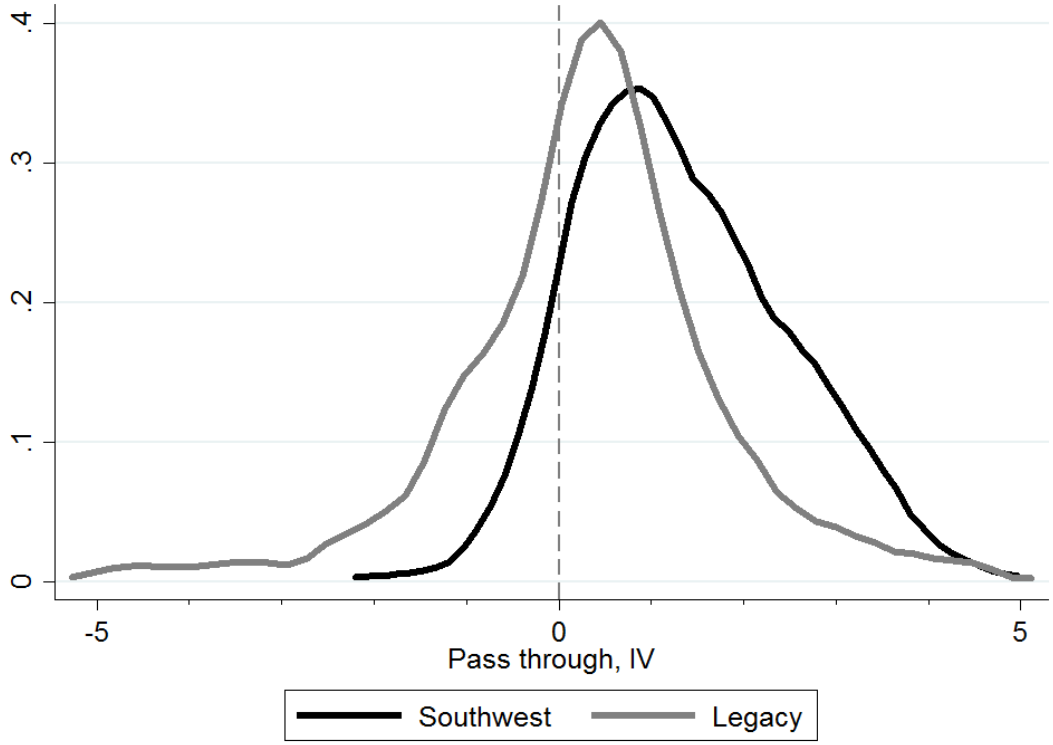
⇒ Carbon pricing *good* for Southwest



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

	Southwest	Legacy carriers
Average carbon cost pass-through	135%	41%
Total profit impact ($50/tCO$_2$)	+$0.3bn	–$4.0bn



⇒ Profits of legacy carriers are *almost wiped out*, across the routes in our dataset, by $50/tCO$_2$ (*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

References

Thank you

Comments welcome: rar36@cam.ac.uk

This talk is mostly based on a forthcoming paper:

Felix Grey & Robert Ritz (2017). “Carbon pricing and firm profits: Theory and estimates for US airlines”. In progress for 2017Q4.

Thank you to Pradeep Venkatesh for excellent research assistance, to EPRG for project funding, and to Severin Borenstein for providing data on US airlines