Modelling Airport Competition: Examples of UK Airports

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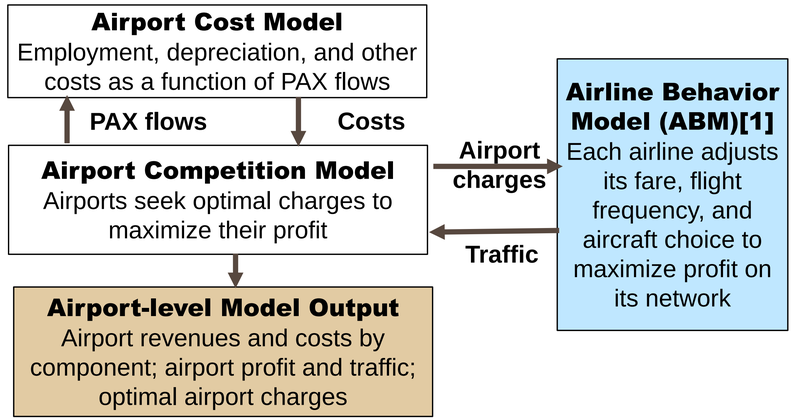
Introduction and Objective

- Decarbonizing aviation is challenging yet essential and demands **coordinated efforts** from all stakeholders.
- **Airports** can play a crucial role, but the **economic risks of decarbonization projects** at airports are often overlooked.
- To fund decarbonization, airports can **adjust their charges**.
- This study simulates the **optimal airport charges** in a competitive environment in response as a test case.

Methodology

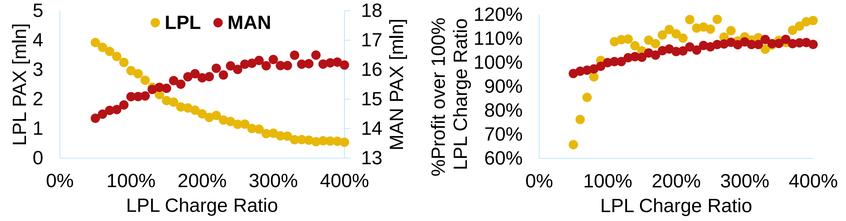
- Airports adjust their charges to optimize their profits in a **n-player non-cooperative game**.
- Airport **costs and non-aero revenues** estimated using financial data from 12 UK airports between 2015 and 2019.
- The airlines' behavior is modeled by the **ABM** [1] using a dynamic European network with fixed intercontinental traffic.
- **Airlines** react to the change in airport charges by adjusting operations and airfares; they can cancel existing routes but cannot (yet) open new ones.
- **Passengers** choose itineraries and whether or not to fly.



Results

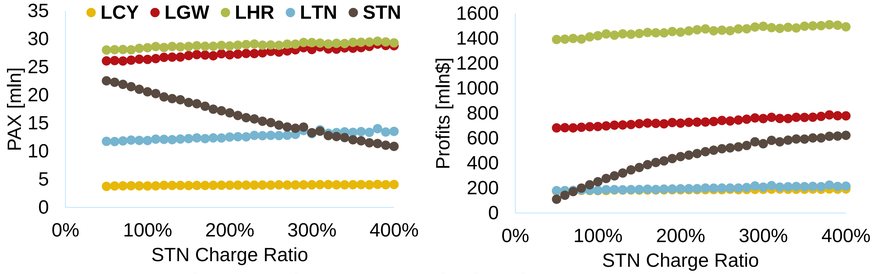
Case 1: Liverpool Airport (LPL) Charges Adjustment

- LPL increases passenger and aircraft charges by the same ratio.
- Manchester airport (MAN) is LPL's competitor at less than 40 km distance. Its charges remain unchanged in this case study.



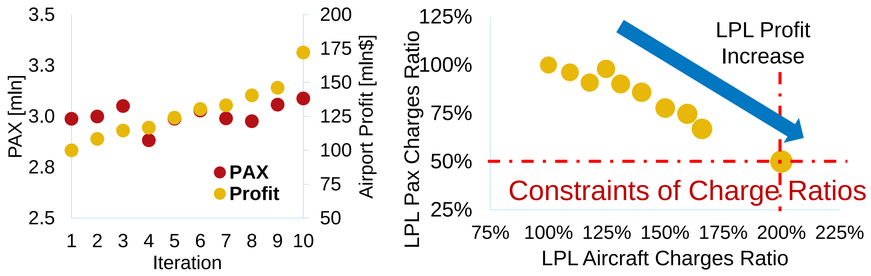
Case 2: London Stansted Airport (STN) Charges Adjustment

- STN increases passenger and aircraft charges by the same ratio.
- Other major London airports assumed to keep charges constant.



Case 3: LPL Airport Charges Optimization

- LPL adjusts passenger and aircraft charges separately to maximize profit, while MAN is assumed to keep charges constant.



Conclusions

- In Case 1, **LPL loses traffic** as its charges increase, with more passengers choosing to travel from MAN instead. **LPL profit has several local maximums after doubling the charges**, and MAN gains more profit as well due to increased traffic.
- In Case 2, **STN percentage-wise retains more passengers** than LPL in Case1 due to capacity constraints at competitor airports, and airlines not being able (yet) to relocate routes in this model. This allows **STN to boost profits by raising charges**, which highlights the need for regulations on dominant airports.
- In Case 3, LPL achieves the highest profit by **minimizing passenger charges and maximizing aircraft charges**. This encourages **airlines to improve their efficiency** by increasing load factors and decreasing flight frequency.

Future work

- Introduce **constraints** that can better reflect airport charge regulations in Europe.
- Introduce the ability for airlines to open **new routes.**
- Enable **multiple airports to maximize profits**.
- Expand analysis to entire **European region**.
- Formulate scenarios for **decarbonization** projects.

References

[1] Doyme, K., Dray, L., O'Sullivan, A., & Schäfer, A. (2019). Simulating Airline Behavior: Application for the Australian Domestic Market. TRR, 2673(2), 104-112.
[2] Adler, N., Brudner, A., Proost, S. (2021). A review of transport market modeling using game-theoretic principles. European Journal of Operational Research, 291(3), 808-829.
[3] Adler, N., Liebert, V. (2014). Joint impact of competition, ownership form and economic regulation on airport performance and pricing. Transportation Research Part A, 64, 92-109.
[4] Evans, A. D. (2014). Comparing the Impact of Future Airline Network Change on Emissions in India and the United States. Transportation Research Part D, 32, 373-386.