Assessing consumer welfare impacts of aviation policy measures

Airline responses, lumpy capacity and hub rationalization
Guillaume Burghouwt

Presentation for ITF Round Table:
Assessing regulatory changes in the transport sector

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Message for today

1. Assessment of economic impacts of aviation investments and policy measures recurrent topic
   - E.g. Deregulation, aviation taxes, increases in competition, airport charges
2. Within a CBA framework, important part of effects are consumer welfare gains/ losses due to changes in travel costs and passenger demand
3. Generally, these are first order impacts. Second order supply effects generally not taken into account
4. But airline seat capacity is lumpy: airlines cannot adapt seat capacity continuously to changing demand.
   - Capacity adjustments: aircraft type changes, frequency changes, route closures/ openings, base closures/ openings
   - Second order impacts can be substantial as lumpiness may leverage initial demand effects
5. Policy makers and regulators should be aware of potential second order supply effects
6. We present a model to take into account first and second order consumer welfare impacts
Outline

- Consumer welfare impacts
- Airline supply responses
- The Hub Network Rationalization Model
- Case study: hypothetical rationalization of the Amsterdam hub
- Conclusions
CBA and consumer welfare impacts

- Investments in aviation infrastructure as well as policy measures increasingly assessed with Cost-Benefit Analysis (CBA)
- Direct consumer welfare impacts/ consumer surplus generally important part of the equation
  - Relate to the changes in generalized travel costs for getting from A to B as a result of a certain policy intervention, as well as the change in demand (market (de)generation)
  - Generalized travel costs: out-of-pocket costs (e.g. ticket fare) + valuation of time
Generalised Travel Cost of an air trip

- **Time costs**
  - In-flight time
  - Transfer time
  - Value of travel time

- **Out-of-pocket costs**
  - Air fare
  - Out-of-pocket costs

- **Frequency**
  - Waiting time for next flight
  - Value of waiting time
  - Frequency costs

**Total Generalised Travel Costs**
NetCost model estimates changes in generalized travel costs, demand and consumer welfare

- Identifies all direct and indirect travel options in a certain market
- Measures all *inconveniences* (=generalized travel costs) to get from initial origin to final destination
  - In the base case (=reference situation) and in a policy scenario

- **NetCost estimates changes in**:
  - Generalized Travel Cost
  - Total passenger demand
  - Demand distribution over various travel options
  - Consumer welfare

See Lieshout & Matsumoto (2012); Lieshout (2012)
Illustration market distribution with NetCost

<table>
<thead>
<tr>
<th>Origin</th>
<th>Hub</th>
<th>Dest.</th>
<th>Carrier</th>
<th>Frequency</th>
<th>Seats</th>
<th>Generalised travel costs (€)</th>
<th>Est. share</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Leg 1</td>
<td>Leg 2</td>
<td>Fare</td>
<td>Time</td>
</tr>
<tr>
<td>CDG</td>
<td>SIN</td>
<td>363</td>
<td>SkyTeam</td>
<td>7</td>
<td>363</td>
<td>995</td>
<td>474</td>
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<tr>
<td>CDG</td>
<td>SIN</td>
<td>409</td>
<td>STAR</td>
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<tr>
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<td>CPH</td>
<td>156</td>
<td>STAR</td>
<td>22</td>
<td>5</td>
<td>676</td>
<td>878</td>
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<td>OneWorld</td>
<td>7</td>
<td>48</td>
<td>750</td>
<td>841</td>
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<td>156</td>
<td>STAR</td>
<td>22</td>
<td>5</td>
<td>676</td>
<td>878</td>
</tr>
<tr>
<td>CDG</td>
<td>AMS</td>
<td>156</td>
<td>SkyTeam</td>
<td>81</td>
<td>6</td>
<td>746</td>
<td>857</td>
</tr>
<tr>
<td>CDG</td>
<td>SGN</td>
<td>315</td>
<td>SkyTeam</td>
<td>7</td>
<td>15</td>
<td>715</td>
<td>897</td>
</tr>
<tr>
<td>CDG</td>
<td>ZRH</td>
<td>156</td>
<td>STAR</td>
<td>41</td>
<td>12</td>
<td>812</td>
<td>850</td>
</tr>
<tr>
<td>CDG</td>
<td>RUH</td>
<td>196</td>
<td>SkyTeam</td>
<td>9</td>
<td>2</td>
<td>564</td>
<td>969</td>
</tr>
<tr>
<td>CDG</td>
<td>BKK</td>
<td>448</td>
<td>STAR</td>
<td>8</td>
<td>65</td>
<td>767</td>
<td>881</td>
</tr>
<tr>
<td>CDG</td>
<td>CAI</td>
<td>258</td>
<td>STAR</td>
<td>11</td>
<td>3</td>
<td>606</td>
<td>963</td>
</tr>
<tr>
<td>CDG</td>
<td>CMB</td>
<td>272</td>
<td>Srilankan Airlines</td>
<td>4</td>
<td>14</td>
<td>650</td>
<td>936</td>
</tr>
</tbody>
</table>

Other indirect travel alternatives 19%
## Example: Consumer Welfare Impacts of Allocation Additional Traffic Rights to a Third Country Carrier

<table>
<thead>
<tr>
<th></th>
<th>Reference Situation</th>
<th>Change</th>
<th>Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Third Country Carrier</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flights/ year</td>
<td>365</td>
<td>365</td>
<td>730</td>
</tr>
<tr>
<td>Passengers / year</td>
<td>146,553</td>
<td>58,060</td>
<td>204,613</td>
</tr>
<tr>
<td><strong>Of which are:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct origin-destination pax</td>
<td>45,041</td>
<td>8,572</td>
<td>53,613</td>
</tr>
<tr>
<td>Beyond the hub pax</td>
<td>101,512</td>
<td>49,488</td>
<td>151,000</td>
</tr>
<tr>
<td><strong>European Carrier</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passengers / year</td>
<td>595,351</td>
<td>-26,969</td>
<td>568,382</td>
</tr>
<tr>
<td><strong>Consumer Welfare Impacts</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumer welfare impact all passengers travelling from/to the European country</td>
<td></td>
<td></td>
<td>EUR 19.7 million</td>
</tr>
<tr>
<td>Consumer welfare impact residents European country</td>
<td></td>
<td></td>
<td>EUR 9.9 million</td>
</tr>
<tr>
<td>Impact on revenues European country carrier</td>
<td></td>
<td></td>
<td>-22%</td>
</tr>
</tbody>
</table>

Source: OAG; NetCost; Note: for illustration purposes only
Other issues to consider when estimating first order consumer welfare impacts

- **It is a network industry!**
  - Direct and indirect (transfer) travel options should be taken into account when assessing the impacts in a certain market

- **The level of pass through**
  - To which extent do airlines pass through cost changes to their clients?

- **Airport capacity constraints**
  - When demand is larger than supply, scarcity rents may arise in the aviation value chain
  - Policy interventions that enlarge capacity at constrained airports may lead to reduction of scarcity rents and lower user prices
  - Increases in airline costs at constrained airports may be absorbed by the airlines at the expense of scarcity rents
Outline

- Consumer welfare impacts
- **Airline supply responses**
- The Hub Network Rationalization Model
- Case study: hypothetical rationalization of the Amsterdam hub
- Conclusions
But what if airlines adjust capacity?

- GTC modelling can be used to estimate *first order* consumer welfare impacts
- However, airlines may react to changing demand and route profitability
  - Such supply reactions will affect generalized travel cost in the market, and again, demand
- Supply reactions are important to consider because airline seat capacity is lumpy at various levels
  - Airlines find it difficult to adjust capacity continuously to changing demand
- Ergo: airline supply function is not smooth but discontinuous (Starkie & Yarrow 2013)
### Example: consumer welfare impacts of allocation additional traffic rights to a third country carrier

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<td>204 613</td>
</tr>
<tr>
<td><strong>Of which are:</strong></td>
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<td></td>
<td></td>
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<td>8 572</td>
<td>53 613</td>
</tr>
<tr>
<td>Beyond the hub pax</td>
<td>101 512</td>
<td>49 488</td>
<td>151 000</td>
</tr>
<tr>
<td><strong>European carrier</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Passengers/ year</td>
<td>595 351</td>
<td>-26 969</td>
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<td><strong>Consumer welfare impacts</strong></td>
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</tr>
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<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>European country</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumer welfare impact residents</td>
<td>EUR 9.9 million</td>
<td></td>
<td></td>
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<tr>
<td>European country</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact on revenues European country carrier</td>
<td>-22%</td>
<td></td>
<td></td>
</tr>
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Source: OAG; NetCost; Note: for illustration purposes only
Airlines can adjust capacity in various ways

- Use of different aircraft
- Adjust route frequency
- Route closure/ opening
- Base closure/ opening
- Hub rationalization/ building

But:

- Flexibility within the own fleet generally limited
- Minimum competitive frequencies may be necessary to keep routes profitable

- Eventual impact on demand/ welfare may be larger than the initial demand/ supply impacts
- Or, as Starkie & Yarrow (2013) put it: *elasticities at airports can be leveraged because of the lumpiness of airline seat capacity*
Outline

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- Airline supply responses
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Hub Network Rationalization (HNR) Model to include the impact of lumpy airline supply decisions on consumer welfare

1. Demand impacts of a policy intervention are estimated using NetCost (or are exogenously given)

2. HNR model then simulates iteratively supply reactions of a (hub) carrier when it is confronted with lower passenger demand
   - Fare, frequency and route adjustments (including route closure)
   - HNR model simulates new airline entry (if feasible)

3. When a stable situation is reached, the model estimates impacts on demand, connectivity, generalized travel costs and consumer welfare (in comparison to a reference situation)
   - HNR model can be used for any airport/airline, but shows its real value at transfer hubs
     - Frequency reductions at one route affect passenger numbers at other routes
HNR-model: estimate initial demand impacts

Policy scenario: airport charges increase

Assumptions on level of pass through

Scenario
Model input
Calculations
Actions
Output

Demand

NetCost

1st order demand effect
HNR-model: assess potential airline responses

Policy scenario: airport charges increase

Assumptions on level of pass through

NetCost → 1st order demand effect → Network (supply)

Load factors below critical level?

Yes → Reduce air fares to restore load factors

No → No further action required

NetCost:

Assumptions on level of pass through

Scenario
Model input
Calculations
Actions
Output
HNR-model: assess potential airline responses and impact on demand

Policy scenario: airport charges increase

Assumptions on level of pass through

NetCost

1st order demand effect

Demand

Network (supply)

Lower load factors

Load factors below critical level?

Reduce air fares to restore load factors

Load factors still below critical level?

Reduce frequency

Frequency below minimum?

No additional frequency reduction

Close route

Demand and revenue losses

No further action required

No further action required

No further action required

Scenario

Model input

Calculations

Actions

Output

Assumptions on level of pass through

No

Yes

Yes

No
HNR-model iterates until stable situation is reached

Policy scenario: airport charges increase

Assumptions on level of pass through

Scenario
Model input
Calculations
Actions
Output

NetCost

1st order demand effect

Transfer flows

2nd and higher order demand effects on route itself and feeding routes

Demand (supply)

Load factors below critical level?

Reduce airfares to restore load factors

Load factors still below critical level?

Reduce frequency

NetCost

No additional frequency reduction

Close route

Load factors below minimum?

Frequency below minimum?

Demand and revenue losses

No further action required

No further action required
Calculate consumer welfare impacts in comparison to reference situation

- Consumer welfare impacts in comparison to reference scenario
  - Demand
  - Network (supply)
  - Load factors below critical level?
    - Yes
      - Reduce air fares to restore load factors
    - No
      - No further action required
  - Lower load factors
  - Reduce air fares to restore load factors
  - Load factors still below critical level?
    - Yes
      - Reduce frequency
    - No
      - No further action required
  - 2nd and higher order demand effects on route itself and feeding routes
  - No additional frequency reduction
  - Close route
    - Yes
    - Frequency below minimum?
      - Yes
      - No further action required
      - No
      - Close route
  - Assumptions on level of pass through
  - Policy scenario: airport charges increase
  - NetCost
  - Scenario
    - Model input
      - Calculations
      - Actions
      - Output
HNR-model in particular suitable for hub airports: feeder relations of the Amsterdam-Detroit (DTW) route

% passenger feed from one route to another
Hub networks robust for rationalization up to a certain point, but there is risk of a ‘domino effect’

Source: HNR-model; MIDT adjusted passenger booking data for Amsterdam Schiphol; OAG data; SEO (2015)
Outline

- Consumer welfare impacts
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Example: rationalization of the SkyTeam hub at Amsterdam to illustrate HNR-model

- Welfare and network impacts of the *hypothetical* rationalization of the SkyTeam network at Amsterdam
- Non-hub scenario: hub carrier and partners decide to close entire hub operation at Amsterdam
- Remaining network will be supported mainly by local OD traffic
- New airlines may enter the market

- Using the HNR-model, what network will remain and what are the consumer welfare impacts?
European network in a non-hub scenario
Intercontinental network in a non-hub scenario

SkyTeam frequency maintained
Direct AMS service cancelled
Destination served by other airlines
SkyTeam frequency decreases
Decrease in the number of directly served routes and frequencies

<table>
<thead>
<tr>
<th>Routes served by hub carrier &amp; partners</th>
<th>Type of route</th>
<th>Number of weekly flights</th>
<th>Number of destinations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Absolute number</td>
<td>% change</td>
</tr>
<tr>
<td>Hub carrier and partners</td>
<td>Other carriers</td>
<td>Total</td>
<td>Hub carrier and partners</td>
</tr>
<tr>
<td>Europe</td>
<td>315</td>
<td>1 051</td>
<td>1 366</td>
</tr>
<tr>
<td>Intercontinental</td>
<td>100</td>
<td>222</td>
<td>323</td>
</tr>
<tr>
<td>Subtotal</td>
<td>415</td>
<td>1 273</td>
<td>1 688</td>
</tr>
<tr>
<td>Other routes</td>
<td>Europe</td>
<td>485</td>
<td>485</td>
</tr>
<tr>
<td>Intercontinental</td>
<td>162</td>
<td>162</td>
<td>0%</td>
</tr>
<tr>
<td>Subtotal</td>
<td>647</td>
<td>647</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>Europe</td>
<td>315</td>
<td>1 536</td>
</tr>
<tr>
<td>Intercontinental</td>
<td>100</td>
<td>384</td>
<td>484</td>
</tr>
<tr>
<td>Total</td>
<td>415</td>
<td>1 920</td>
<td>2 336</td>
</tr>
</tbody>
</table>
Consumer welfare impacts in a non-hub scenario (x mln year) in comparison to the 2013 situation

<table>
<thead>
<tr>
<th>Effects for Dutch users of air transport services</th>
<th>Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fare/ competition</td>
<td>Non-hub -66</td>
</tr>
<tr>
<td></td>
<td>Partial dehubbing -20</td>
</tr>
<tr>
<td>Connectivity</td>
<td>Non-hub -154</td>
</tr>
<tr>
<td></td>
<td>Partial dehubbing -46</td>
</tr>
<tr>
<td>Landside access costs</td>
<td>Non-hub -370</td>
</tr>
<tr>
<td></td>
<td>Partial dehubbing -78</td>
</tr>
<tr>
<td>Total</td>
<td>Non-hub -590</td>
</tr>
<tr>
<td></td>
<td>Partial dehubbing -145</td>
</tr>
</tbody>
</table>
Outline

- Consumer welfare impacts
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Conclusions

- *First order* consumer welfare impacts in air transport can be assessed using the usual transport model formulations.
- However, airline seat capacity is lumpy.
  - Airlines cannot adjust capacity continuously to changing demand.
- Lumpiness can leverage initial elasticities.
- Rationalization of airline hubs can eventually result in a ‘domino effect’, although hubs are quite robust up to a certain level.
- The HNR-model allows to estimate (part of) the second order impacts.
Policy recommendations

- Policy makers and regulators should take into account risk of potential second order supply impacts.
- Applications of the presented approach are numerous:
  - (De)regulation of aviation markets
  - Impact of greater airline competition
  - Introduction of air travel taxes
  - Changes in airport charges, ATC costs, security costs