Measuring the impact of leasing on airlines' cost efficiency: a stochastic frontier analysis

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Aircraft Leasing  Growth over the last 50 years

Percentage of global commercial airline fleet leased

Lessors account for ~40% of the world fleet

Total Growth | past 20 Years:

World Fleet  x2

Owned Fleet  x1.5

Leased Fleet  x4

Source: Flightglobal Ascend fleet database for units and CAPA
Research motivation

- Leasing has become an essential means for financing aircraft
- However leasing is more costly than buying!

Leasing drivers:
- Capital requirement
- Access to credit
- Flexibility

Economic Profit (2002-09, cumulative $ mln)

Leased fleet/Total Fleet**

* Copa, Air Arabia and Aegean data for 2004-09 period only, Allegiant 2005-09 period
** Average value of leased fleet (estimated as operating lease expense * 8) divided by (value of PPE+leased fleet value) over the 2002-2009 period
Efficiency gains

- Increased uncertainty on demand and access to credit
- Market structure changes (entry, mergers, new business models…)
- Leasing, even if more costly, allows for:
  - Open new routes
  - Fleet adjustments to demand, to
  - Reduce capacity

- Question: How do leasing choices, through increased flexibility, reduce airlines operational costs inefficiency?
The Model: Cost frontier approach

- Cost Frontier: minimum expenditure required to produce a given amount of service, given:
  - The prices of the inputs used in its production \((w)\)
  - The production technology in place
- Program of the firm:
  \[
  \min_x C(x, \theta - g(L))
  \]
  subject to
  \[
  f(x, K, z) = Q
  \]
- The associated cost function, for an airline \(i\), \(i=1,\ldots,N\) and at time \(t\), \(t=1,\ldots,T\):
  \[
  C_{it} = C(Q_{it}, w_{it}, K_{it}, z_{it}, \theta_{it} - g(L_{it}); \beta)
  \]
Empirical Implementation

- Estimated Cost function (Cobb-Douglas):

\[ C_{it} = \beta_0 Q_{it}^{\beta_Q} K_{it}^{\beta_K} w_{lit}^{\beta_l} w_{eit}^{\beta_e} w_{mit}^{\beta_m} z_{it}^{\beta_z} \exp\left(\theta_{it} - \left(\gamma_L L_{it} + \gamma_2 L_{it}^2\right) + u_{it}\right) \]

\[ \ln C_{it} = \ln \beta_0 + \beta_Q \ln Q_{it} + \beta_K \ln K_{it} + \beta_l \ln w_{lit} + \beta_e \ln w_{eit} + \beta_m \ln w_{mit} + \beta_z \ln z_{it} + \theta_{it} - \left(\gamma_L L_{it} + \gamma_2 L_{it}^2\right) + u_{it} \]

\( \Leftarrow \)

Costs \quad \downarrow \quad \text{Production} \quad \downarrow \quad \text{Capital} \quad \downarrow \quad \text{Input prices} \quad \downarrow \quad \text{Exogenous factors} \quad \downarrow \quad \text{Effect of Leasing}

- Estimation technique:
  - Potential endogeneity of leasing: Instrumental Variables (2SLS)
  - Fixed effects
  - Stata
The Data: Sources and Variables

- 247 international airlines (different business models and experience)
- Yearly data: 2007-2016
- Data sources:
  - Financial and operating information: The Airline Analyst, Bloomberg
  - Macroeconomic and Governance data: US Department of Agriculture Research, KPMG Corporate tax surveys, companies websites

- Costs: Total EBITDAR Expenses
- Production: ASK
- Capital: Number of aircraft in the fleet
- Input Prices: Labor (employee costs per FTE), Energy (fuel and oil), Maintenance and Other Ebitdar Costs (landing fees, selling charges,…)
- Leasing: Proportion of operating leased aircraft in the fleet
- Exogenous factors: Competition, GDP, Government holdings,…
## Results

<table>
<thead>
<tr>
<th>Variables</th>
<th>Parameter</th>
<th>T-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lease</td>
<td>2.09</td>
<td>4.05</td>
</tr>
<tr>
<td>$Lease^2$</td>
<td>-1.72</td>
<td>-3.85</td>
</tr>
<tr>
<td>Nb of Aircraft</td>
<td>.32</td>
<td>10.75</td>
</tr>
<tr>
<td>Available Seat Km</td>
<td>.33</td>
<td>9.77</td>
</tr>
<tr>
<td>Labour cost</td>
<td>.13</td>
<td>5.39</td>
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<tr>
<td>Energy cost</td>
<td>.27</td>
<td>12.41</td>
</tr>
<tr>
<td>Maintenance cost</td>
<td>.14</td>
<td>7.17</td>
</tr>
<tr>
<td>Other costs</td>
<td>.21</td>
<td>5.37</td>
</tr>
</tbody>
</table>

All parameters significant at the 5% level.
Findings

Our main results:
1. Leasing allows airlines to reduce inefficiency
2. Inefficiency exhibits increasing marginal returns to leasing
3. Optimal level of leasing that minimizes the operational inefficiency: 60.5%
   Confidence interval [0.57;0.64]
Further research

- Airlines optimally choose the proportion of leasing to improve flexibility and reduce inefficiency:
  1. Airlines minimize total costs w.r.t leasing
  2. Improving flexibility through leasing is costly (effort)
  3. Demand function is included
  4. FOC: optimal level of leasing is computed
  5. Optimal level of leasing reintroduced in the cost function

- Estimation of the resulting cost function (SFA, MLE)
- Computation of the optimal level of leasing, for each airline
- Comparison of the optimal and the observed levels of leasing
Thank you