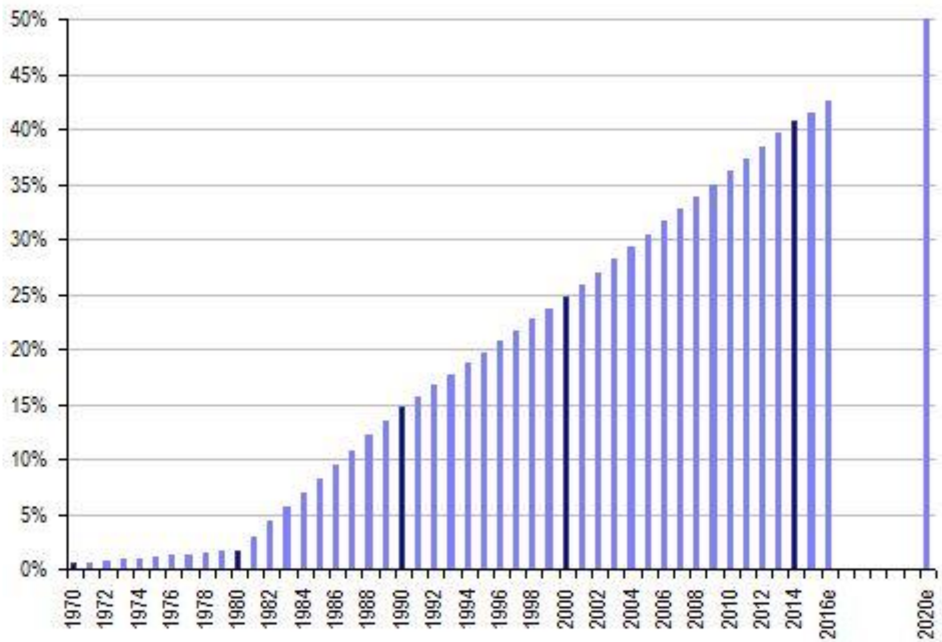
Measuring the impact of leasing on airlines' cost efficiency: a stochastic frontier analysis

Sylvain Bourjade and Catherine Muller, TBS

Aircraft Leasing Growth over the last 50 years

Percentage of global commercial airline fleet leased



Lessors account for ~40% of the world fleet

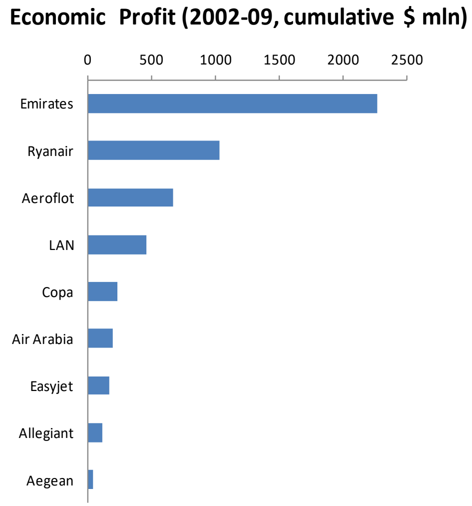
Total Growth | past 20 Years:

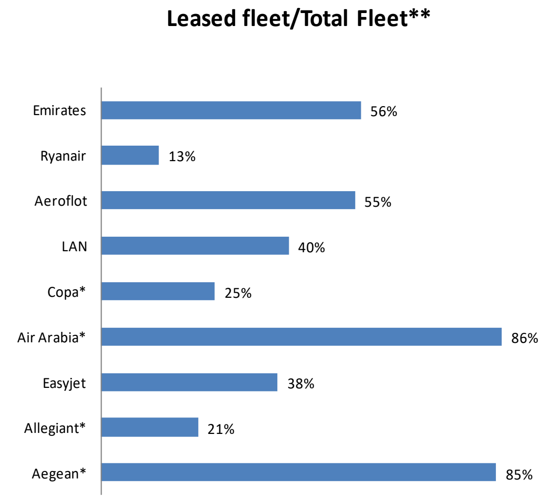
World Fleet	Owned Fleet	Leased Fleet
x2	x1.5	x4

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!





* 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

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

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:

fleet ajustements to demand, to → Open new routes / → Reduce capacity

- Question: How do leasing choices, through increased flexibility, reduce airlines operational costs inefficiency?

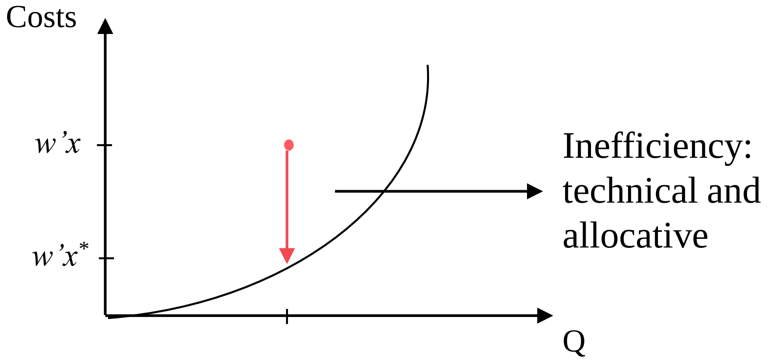
The Model: Cost frontier approach

- 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:

$$\underset{x}{Min}\ C\left(wx, \theta - g\left(L\right)\right)$$

subject to

$$f\left(x, K, z\right) = Q$$



- The associated cost function, for an airline *i*, *i*=1,…,*N* and at time *t*, *t*=1, …, *T*:

$$C_{it} = C\left(Q_{it}, w_{it}, K_{it}, z_{it}, \theta_{it} - g\left(L_{it}\right); \beta\right)$$

Empirical Implementation

- Estimated Cost function (Cobb-Douglas):

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

$$\Leftrightarrow$$

$$\ln C_{it} = \ln \beta_0 + \beta_Q \ln Q_{it} + \beta_K \ln K_{it} + \underbrace{\beta_l \ln w_{lit} + \beta_e \ln w_{eit} + \beta_m \ln w_{mit}}_{\text{Input prices}} + \beta_z \ln z_{it} + \theta_{it} \underbrace{- \left(\gamma_L L_{it} + \gamma_2 L_{it}^2\right)}_{\text{Effect of Leasing}} + u_{it}$$

Inefficiency (θ_{it})

Costs ($\ln C_{it}$); Production ($\ln Q_{it}$); Capital ($\ln K_{it}$); Input prices; Exogenous factors ($\ln z_{it}$); 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

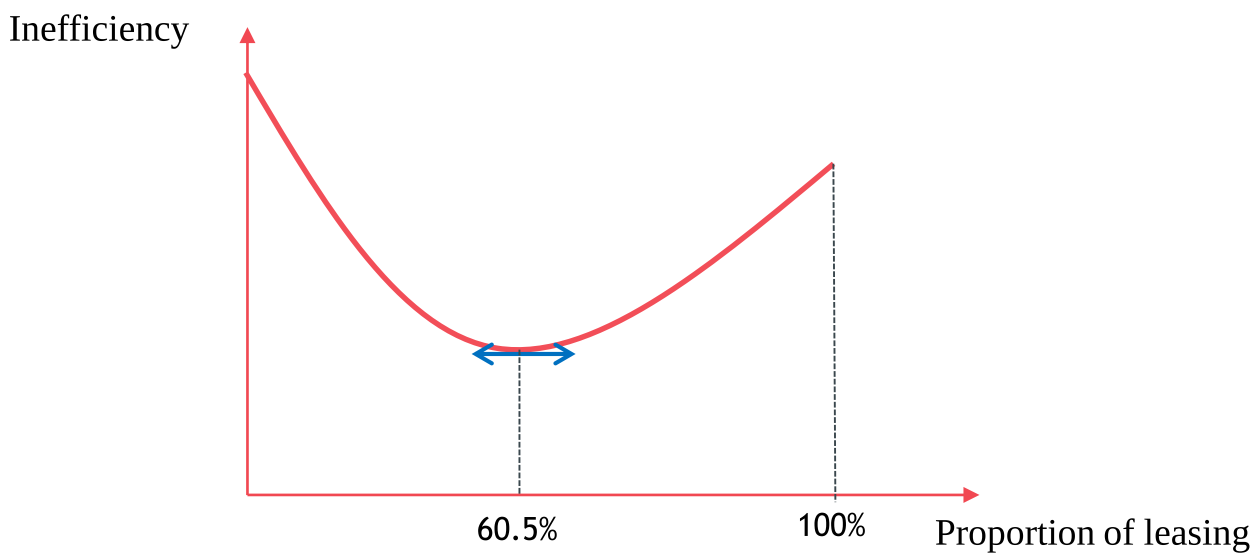
Variables	Parameter	T-value
Lease	2.09	4.05
Lease^2	-1.72	-3.85
Nb of Aircraft	.32	10.75
Available Seat Km	.33	9.77
Labour cost	.13	5.39
Energy cost	.27	12.41
Maintenance cost	.14	7.17
Other costs	.21	5.37

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