Cologne Business School

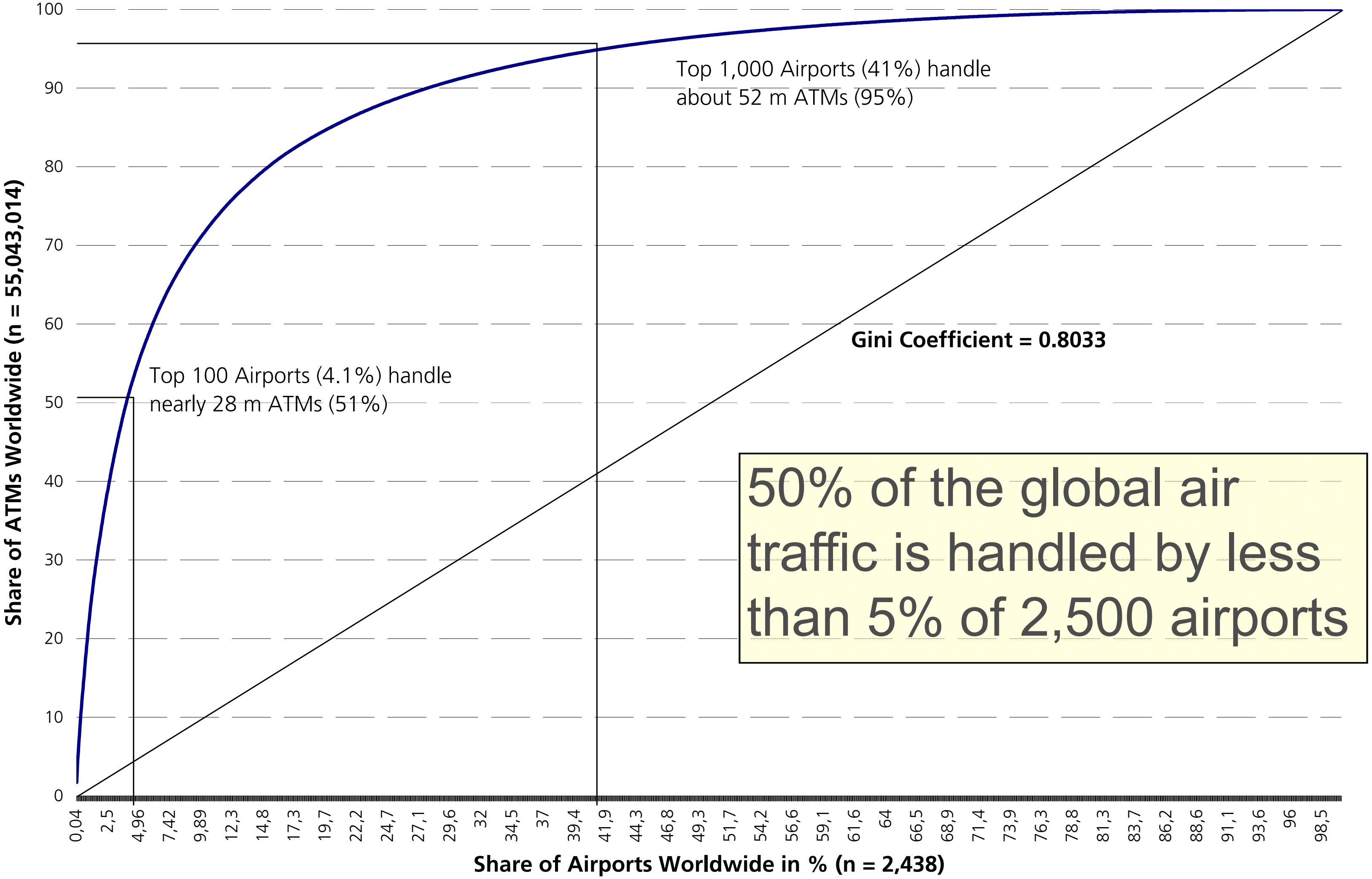
21.03.2012

Airport capacity constraints & air travellers' airport choice behaviour – from global constraints to local effects

Dr. Marc C. Gelhausen

DLR Deutsches Zentrum für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

Cumulative distribution of global ATMs on airports in 2008



Reichmuth/Berster/Gelhausen (2011), CEAS Aeronautical Journal 2 (1-4), pp. 21

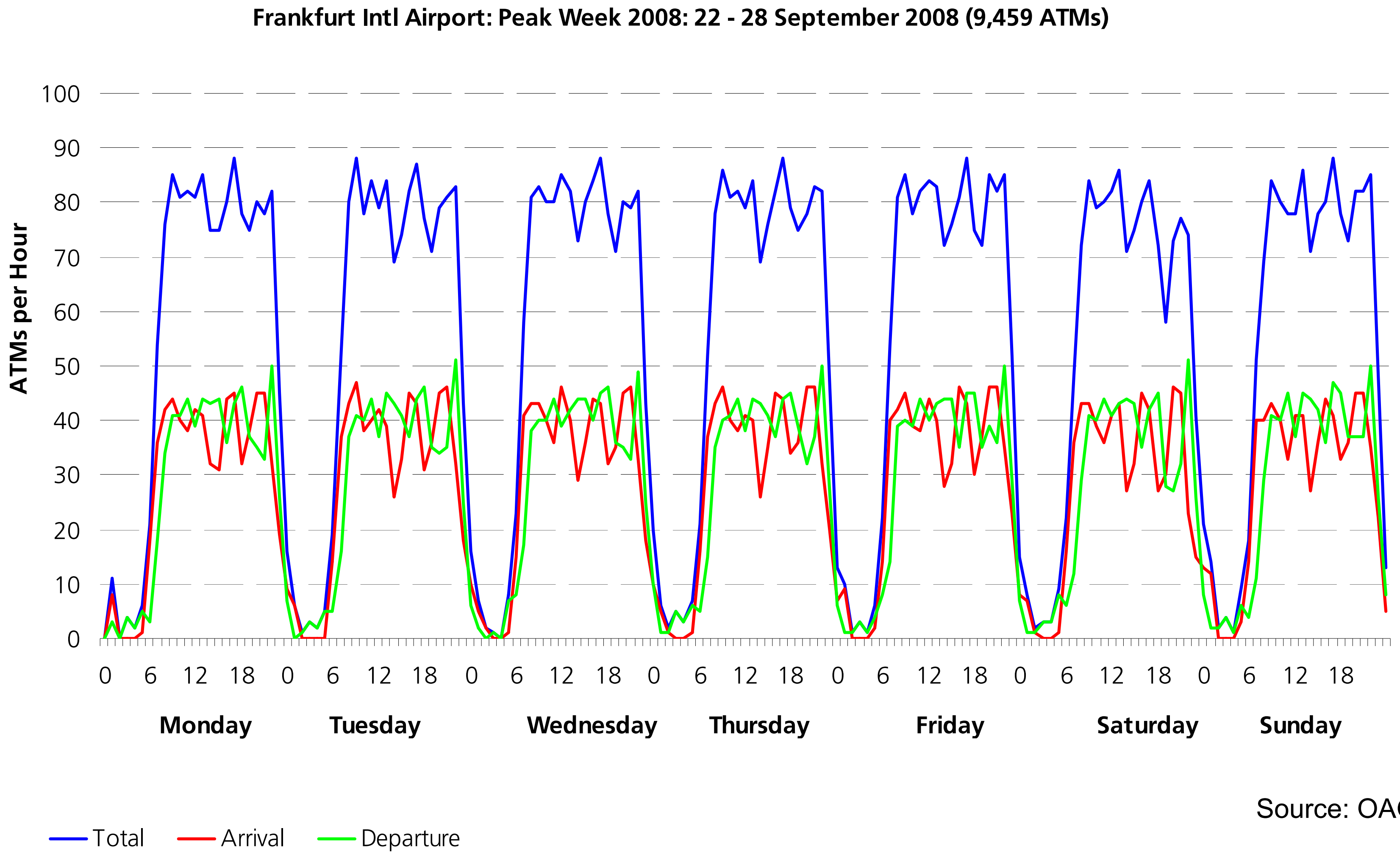
Why consider capacity constraints in airport choice?

Limited airport infrastructure:

- Runways
- Terminals
- Night curfews
- Noise/emissions/political restrictions

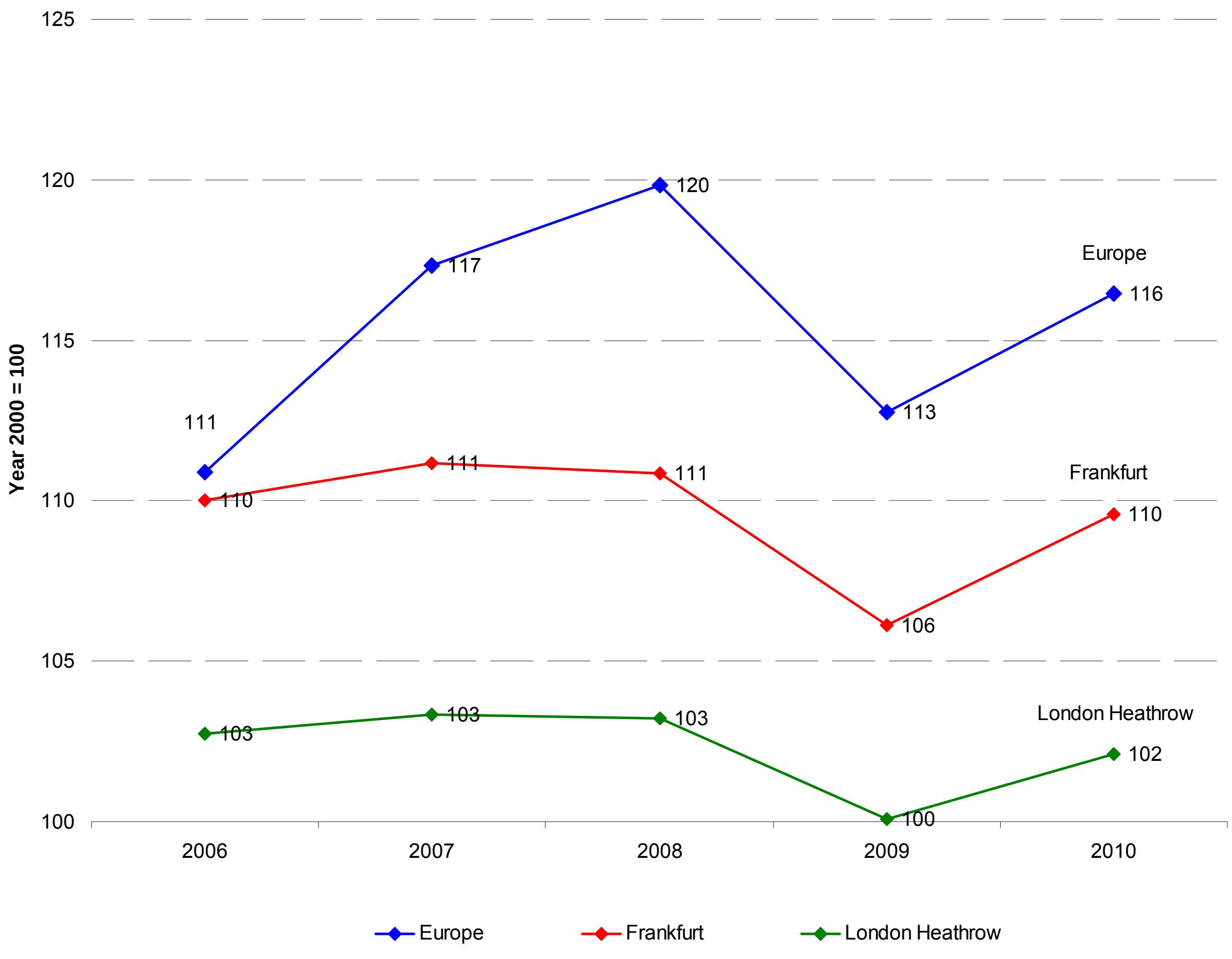
Affects available airport capacity to handle air passenger demand

Hourly variation of flight movements at Frankfurt Airport



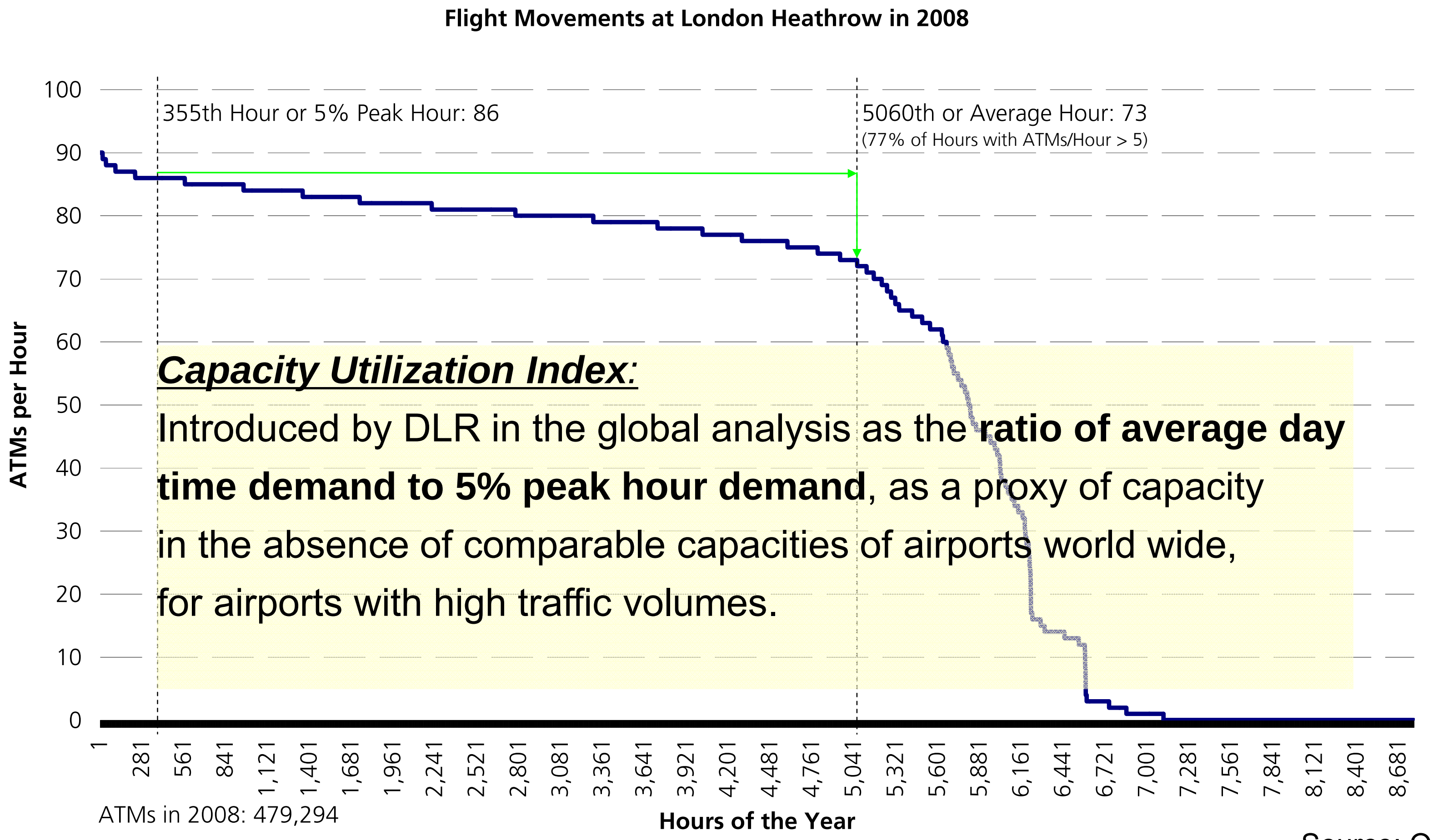
Source: OAG, DLR

Development of air traffic volume 2000 – 2010 at LHR & FRA



Reichmuth/Berster/Gelhausen (2011), CEAS Aeronautical Journal 2 (1-4), pp. 21

Traffic ranking by hours of operation of the year 2008 at London Heathrow Airport; CUI = 0.85

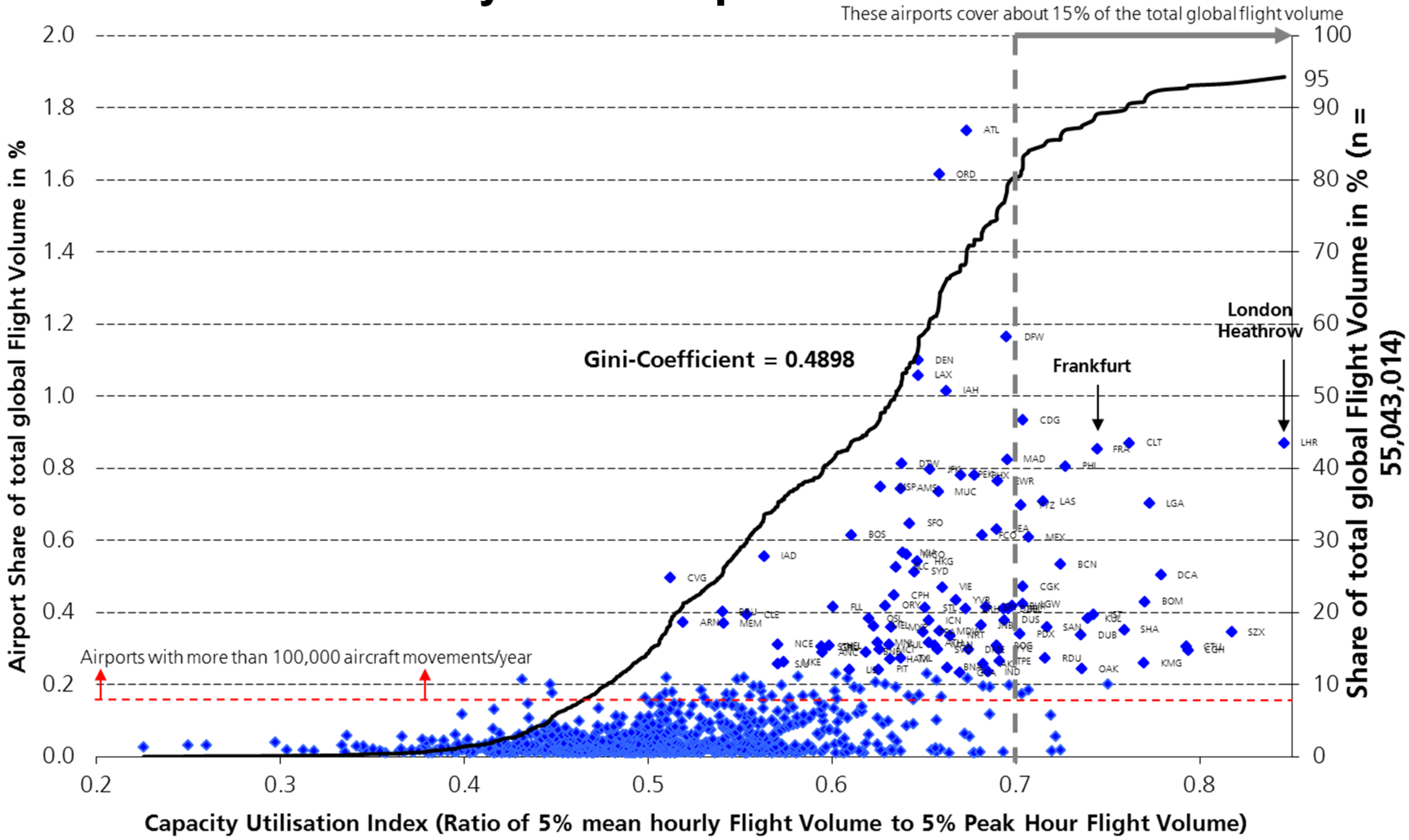


<u>Capacity Utilization Index</u>:

Introduced by DLR in the global analysis as the **ratio of average day time demand to 5% peak hour demand**, as a proxy of capacity in the absence of comparable capacities of airports world wide, for airports with high traffic volumes.

Source: OAG, DLR

CUI analysis of airports worldwide



Reichmuth/Berster/Gelhausen (2011), CEAS Aeronautical Journal 2 (1-4), pp. 21

General model structure of the capacity constraints forecast and hypothesis about interdependencies

Attitude of Population towards Air Transport

- Welfare Level −
- Age Structure −
- Tourism +
- ...

Government and social Values

- Democracy −
- Ministry of Environment −
- ...

Location and Size of an Airport

- Noise −
- Number of Flights −
- Airport Category −
- ...

Intermodal Substitution

- Railway Km −
- Country Size +
- ...

Acceptance & speed to improve airport capacities

+: Positive wrt Improvement

-: Negative wrt Improvement

Main questions in modelling capacity constraints

How is the individual air passenger affected:

<u>Given his chosen destination ...</u>

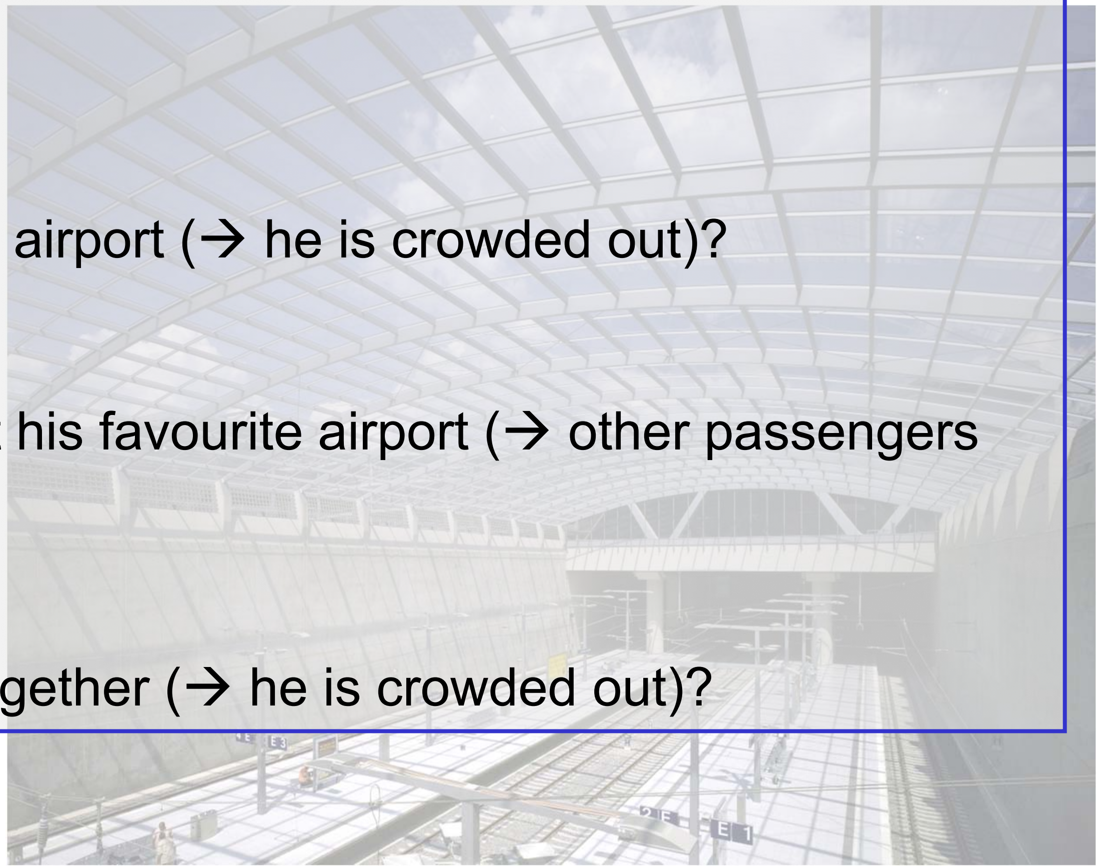
• Does he **change** his departure airport (→ he is crowded out)?

or

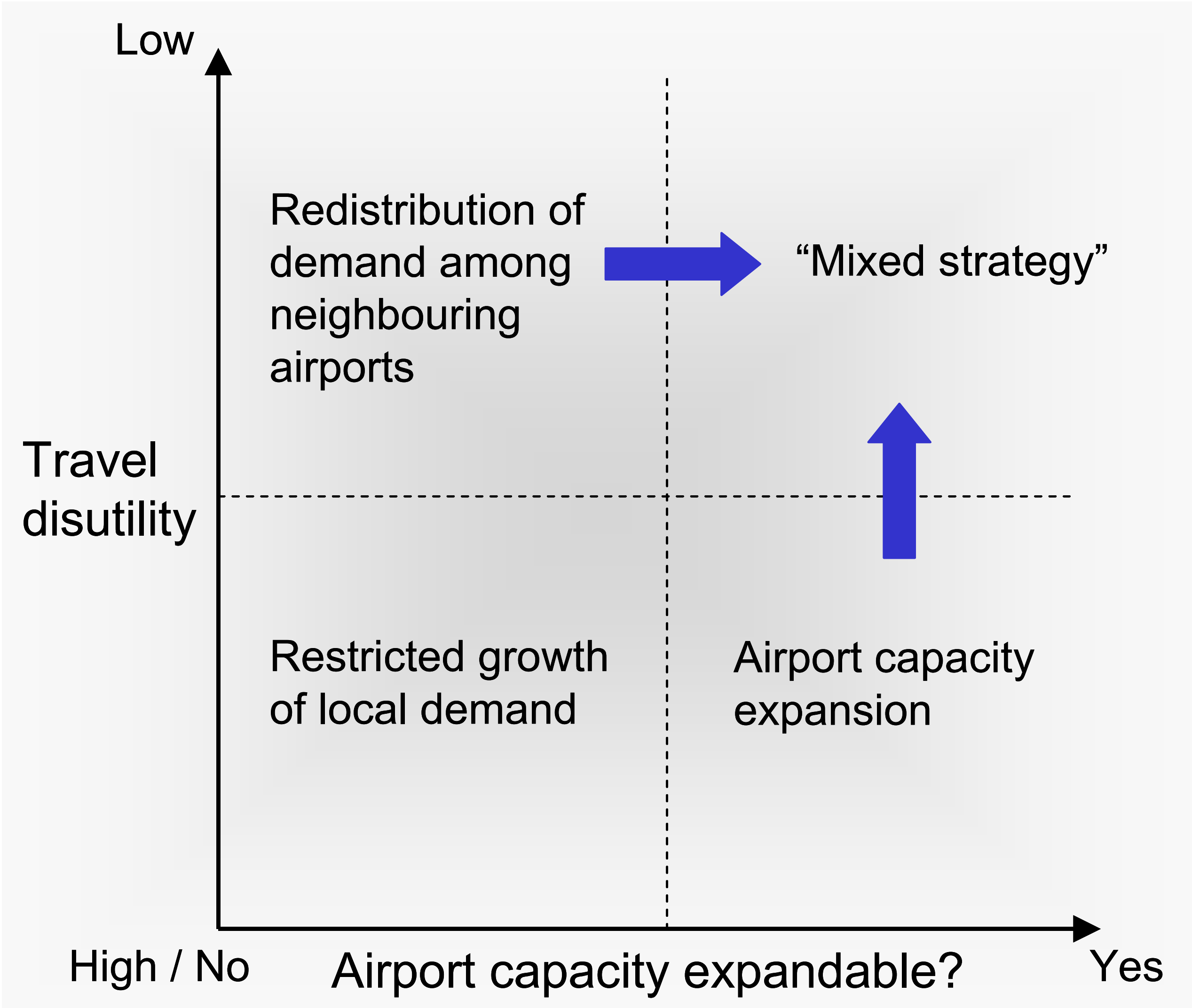
• Does he **pay a higher price** at his favourite airport (→ other passengers are crowded out)?

or

• Does he **cancel** his air trip altogether (→ he is crowded out)?



Possible consequences of capacity constraints at airports



Gelhausen (2009), Journal of Airport Management 3(4), pp. 366

Forecasting philosophy of a nested logit-model

Traveller: „Which alternative is the best for me?"

Evaluation of alternatives by means of utility

Lack of observability, measurement errors, …

Forecaster: „ Which alternative is most likely the best for him?"

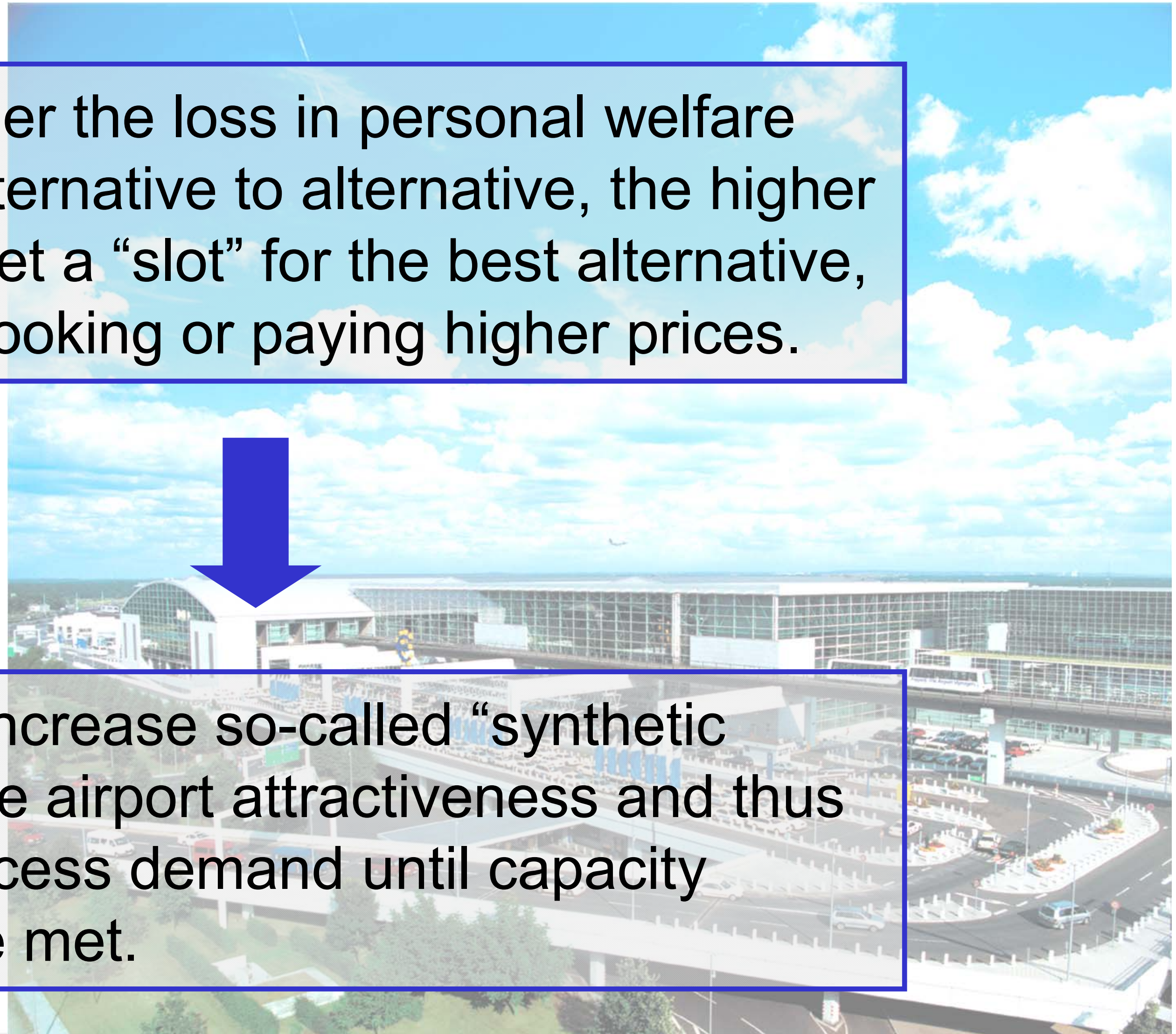
Choice probabilities

Summing up over homogenous populations

Market segment specific market shares of all alternatives

Gelhausen (2008), Journal of Airport Management 2(4), pp. 355

Modelling capacity constraints in airport choice - conceptual

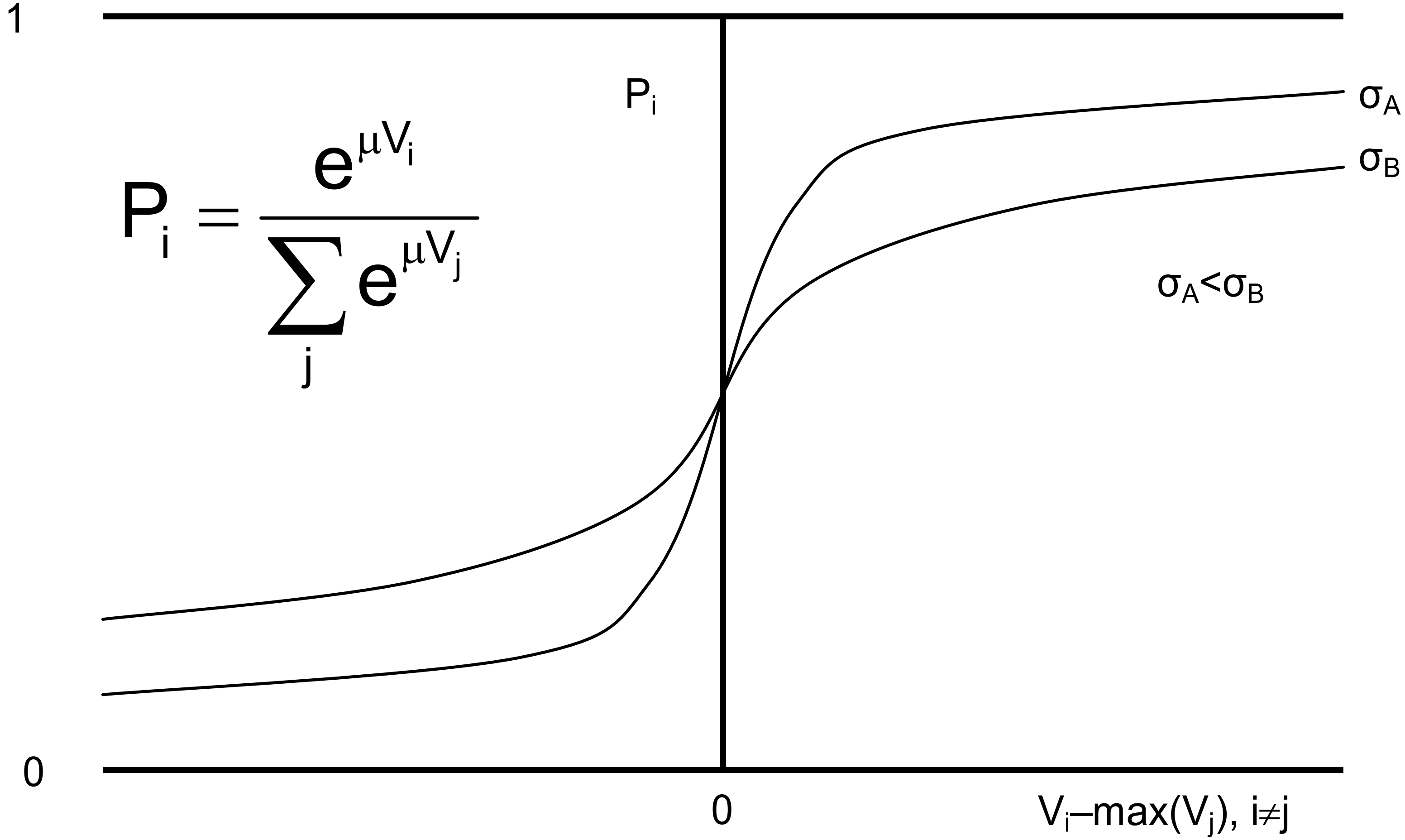


Idea: The higher the loss in personal welfare (utility) from alternative to alternative, the higher the efforts to get a “slot” for the best alternative, e.g. by early booking or paying higher prices.

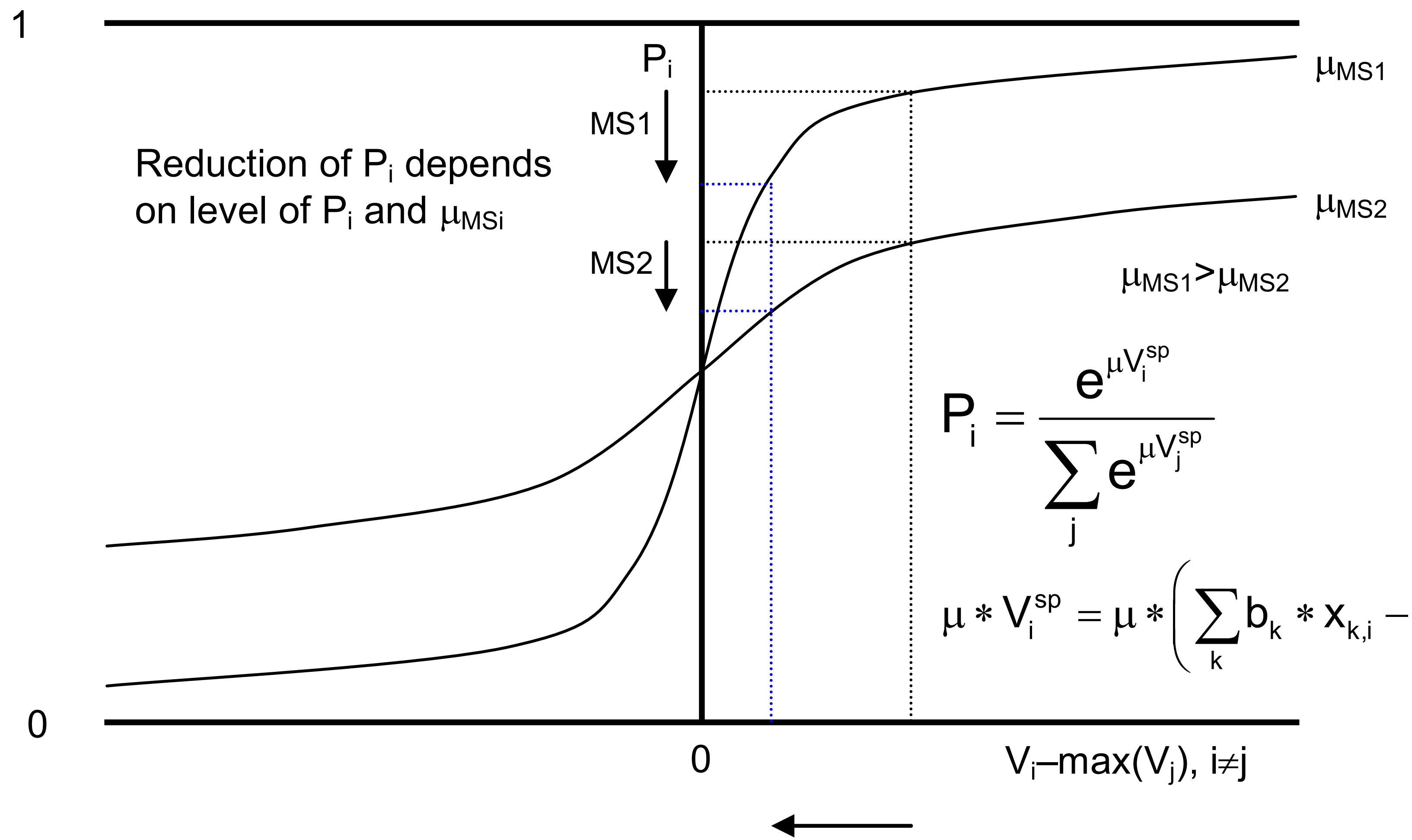
Realisation: Increase so-called “synthetic price” to reduce airport attractiveness and thus redistribute excess demand until capacity constraints are met.

Modelling capacity constraints in airport choice (I)

$$P_i = \frac{e^{\mu V_i}}{\sum_j e^{\mu V_j}}$$



Modelling capacity constraints in airport choice (II)



Reduction of P_i depends on level of P_i and μ_{MSi}

$$P_i = \frac{e^{\mu V_i^{sp}}}{\sum_j e^{\mu V_j^{sp}}}$$

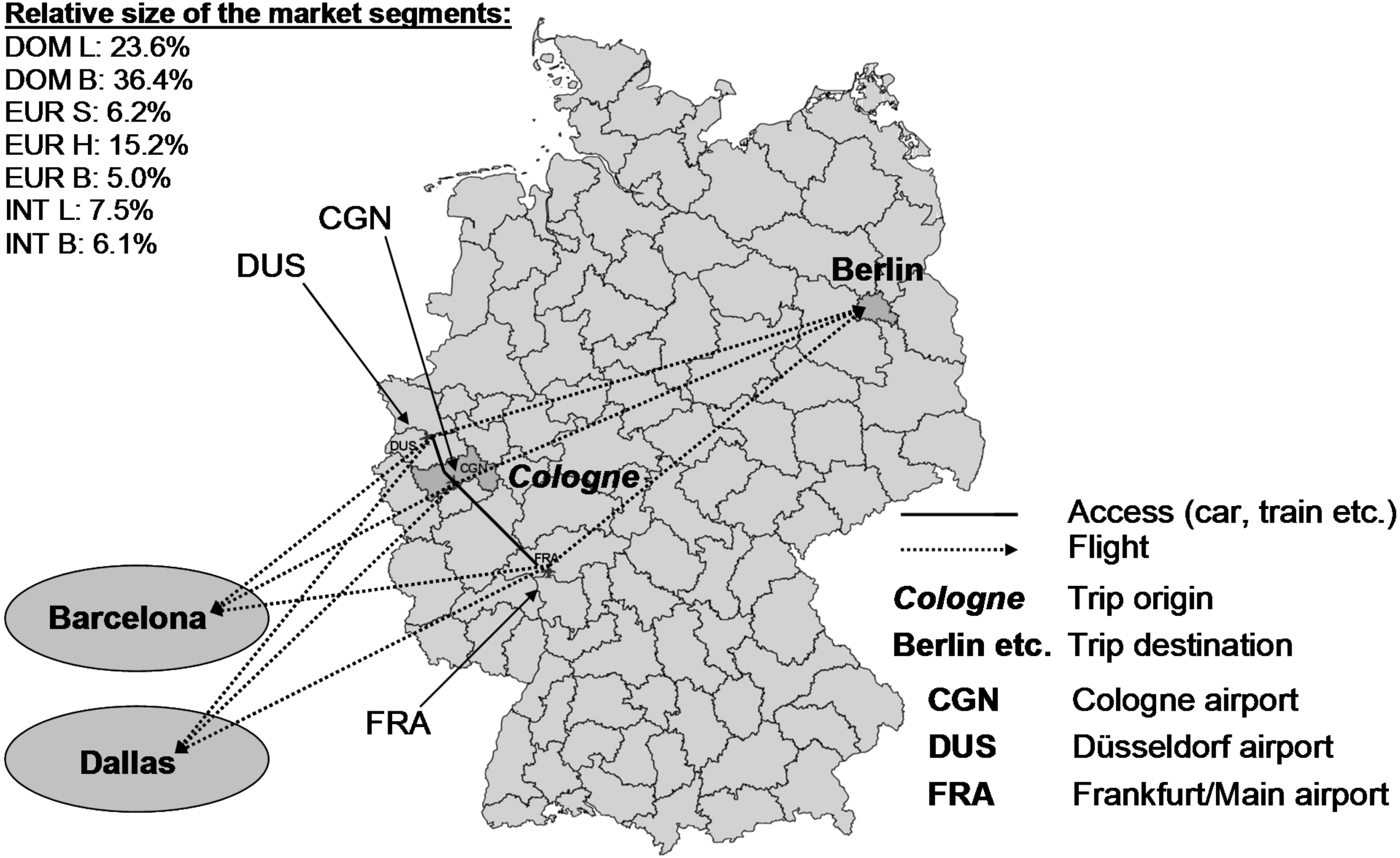
$$\mu * V_i^{sp} = \mu * \left(\sum_k b_k * x_{k,i} - x_i^{sp} \right)$$

Decrease of V_i to meet capacity constraints

Example: Airport choice in the Cologne region

Relative size of the market segments:

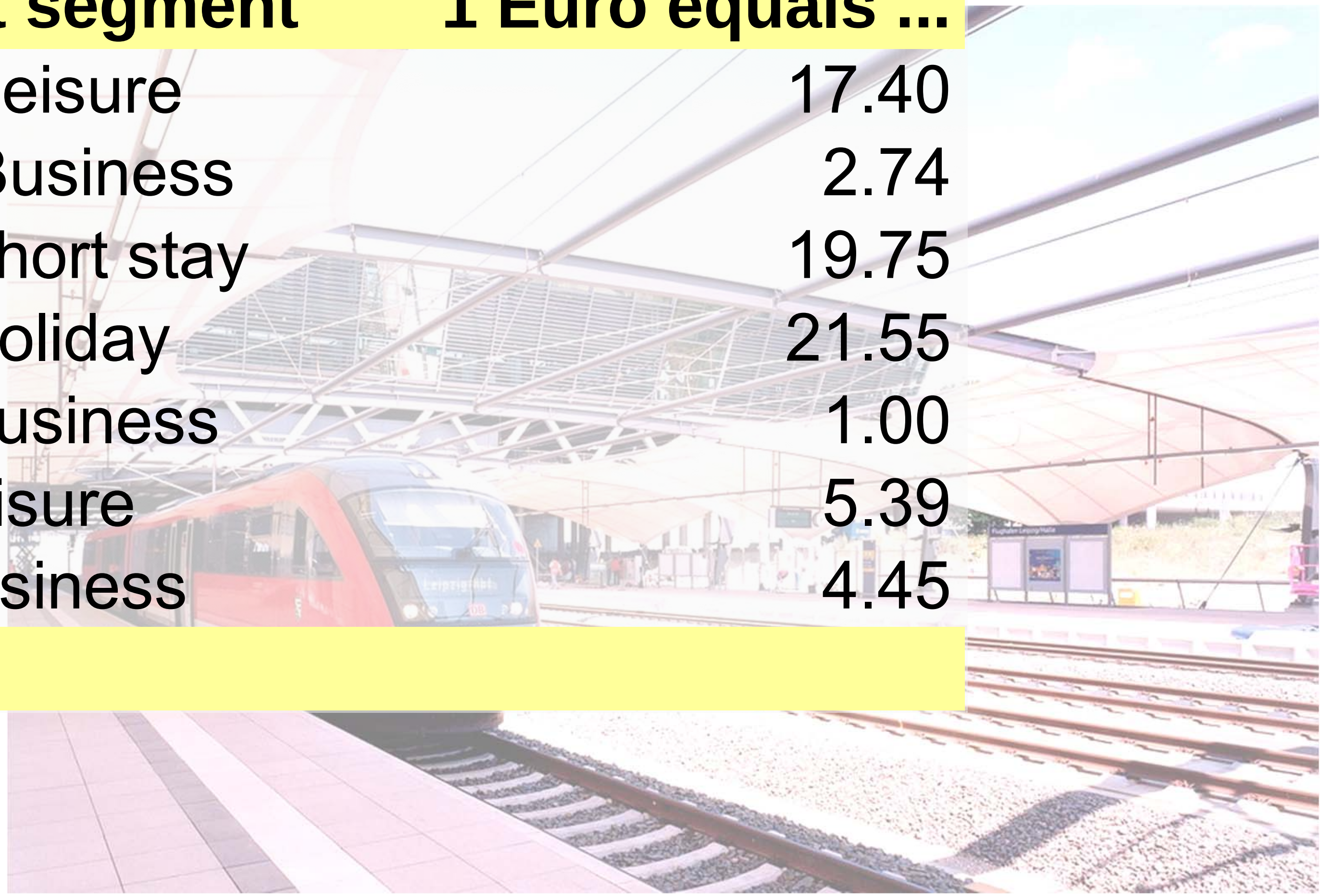
DOM L: 23.6%
DOM B: 36.4%
EUR S: 6.2%
EUR H: 15.2%
EUR B: 5.0%
INT L: 7.5%
INT B: 6.1%



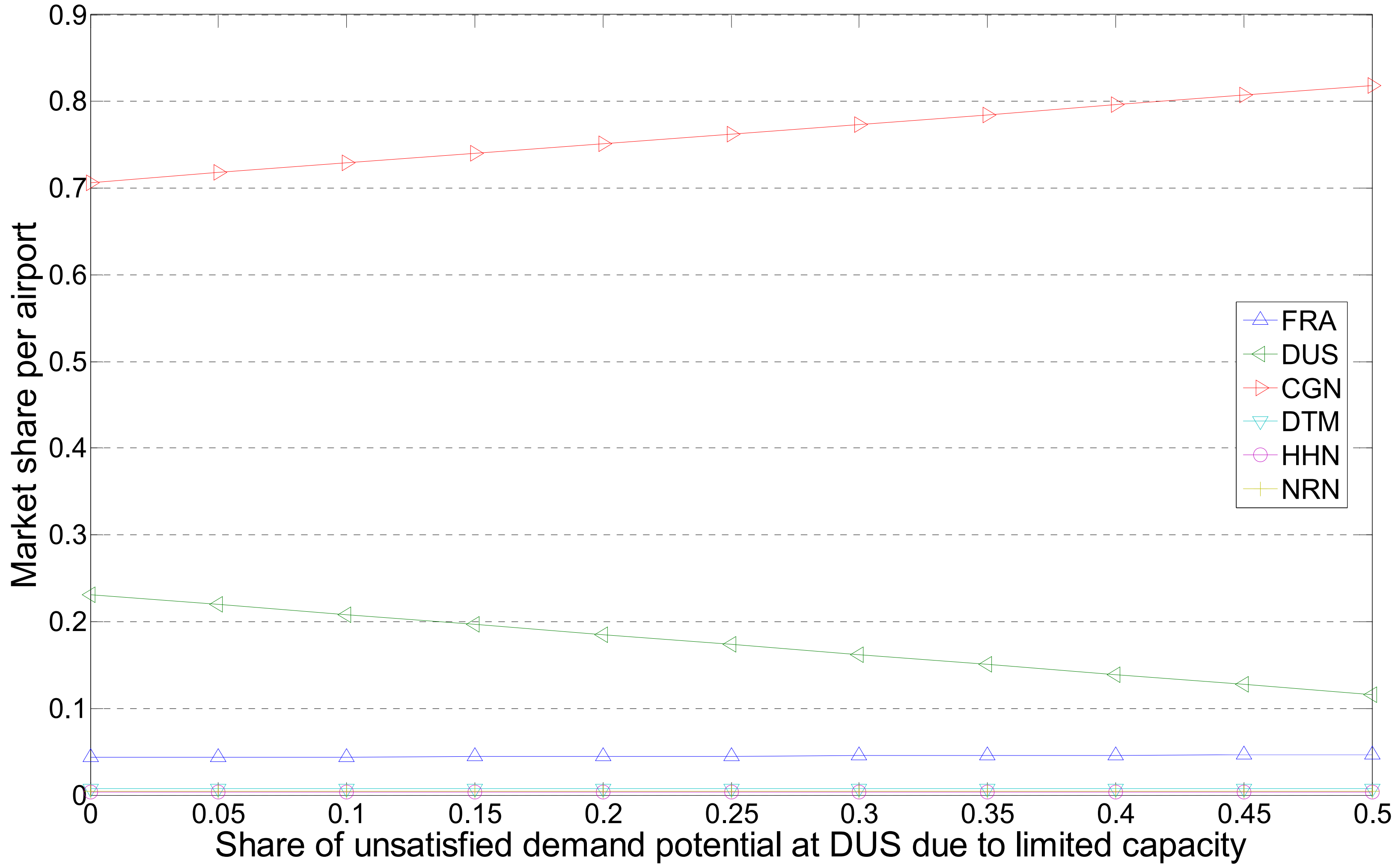
Gelhausen (2008), Journal of Airport Management 2(4), pp. 355

Willingness-to-pay by market segment

Market segment	1 Euro equals ...
DOM Leisure	17.40
DOM Business	2.74
EUR Short stay	19.75
EUR Holiday	21.55
EUR Business	1.00
INT Leisure	5.39
INT Business	4.45

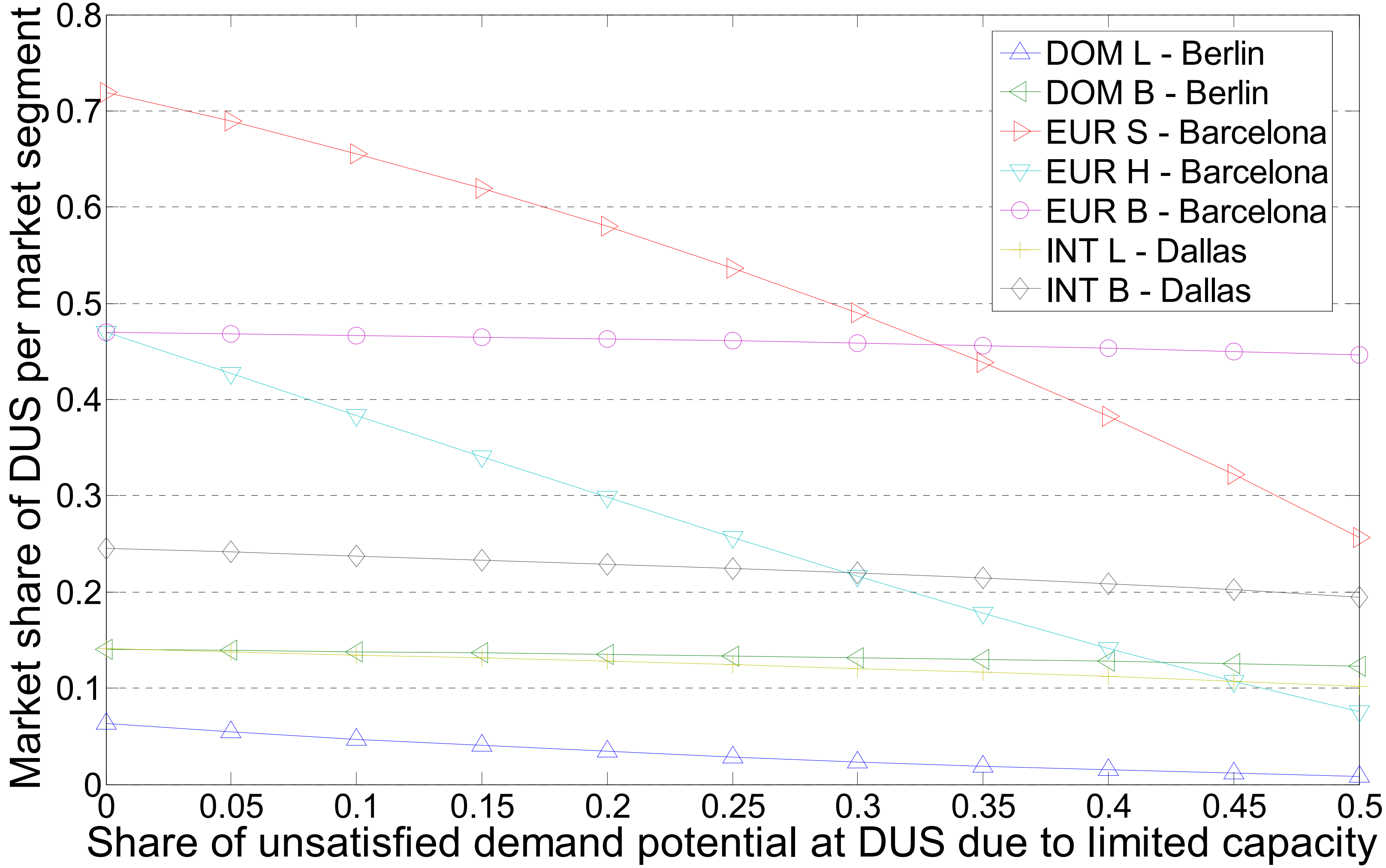


Total market share of DUS wrt capacity constraints



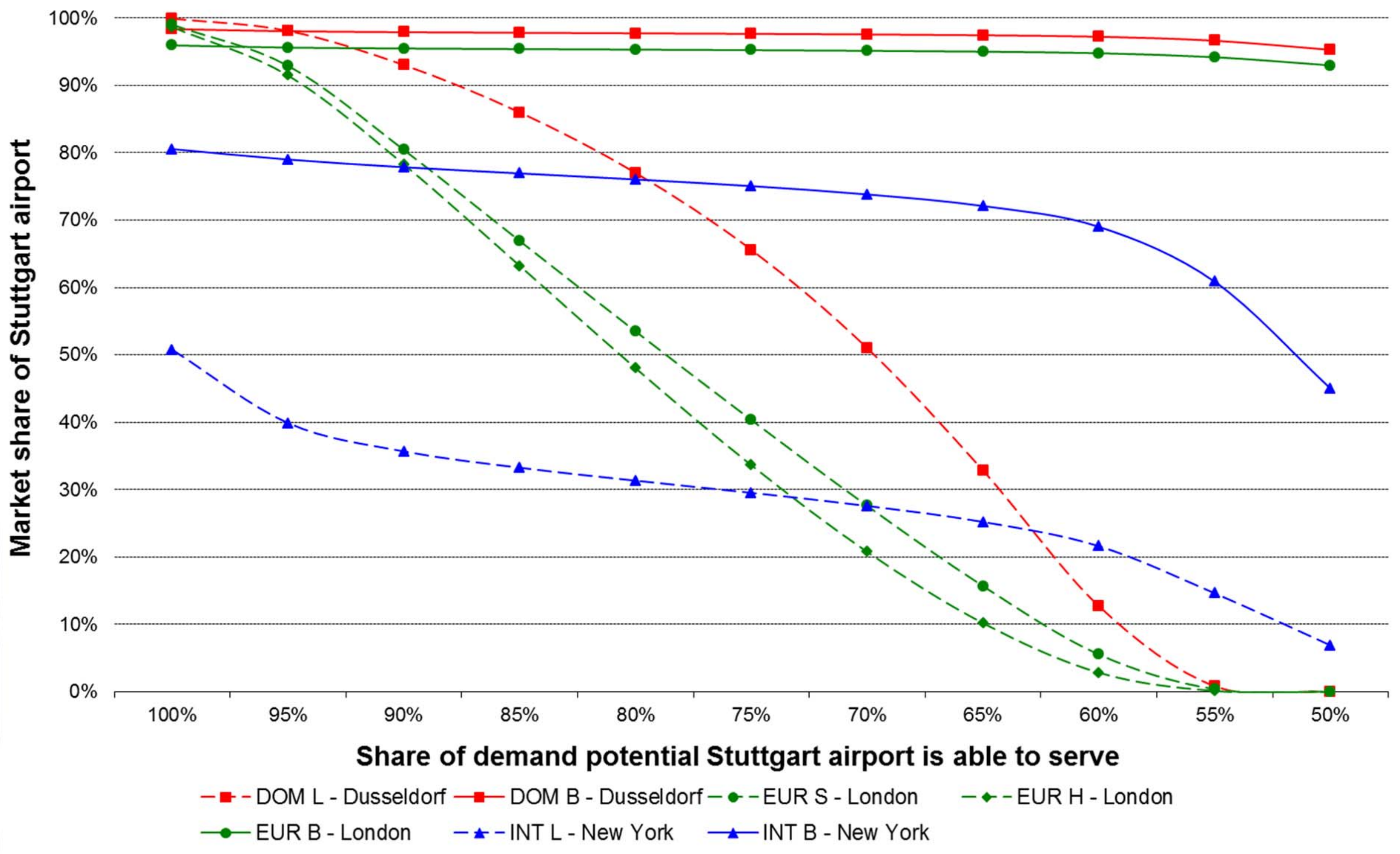
Gelhausen (2009), Journal of Airport Management 3(4), pp. 366

Market shares by segment at DUS wrt capacity constraints



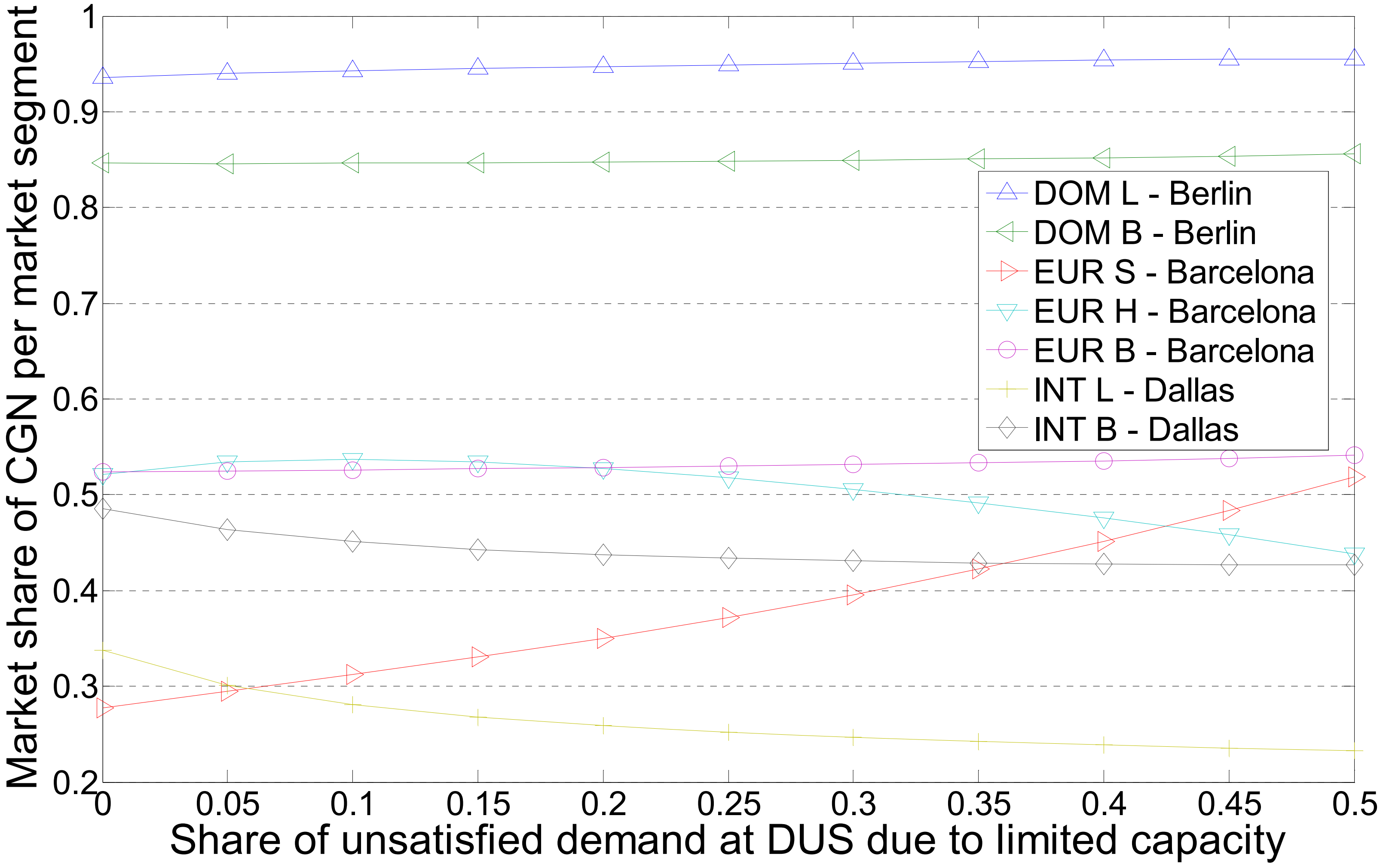
Gelhausen (2009), Journal of Airport Management 3(4), pp. 366

Market shares by segment at STR wrt capacity constraints



Gelhausen (2011), Journal of Air Transport Management 17, pp. 116

Effects of capacity deficit at DUS on market segments at CGN



Gelhausen (2009), Journal of Airport Management 3(4), pp. 366

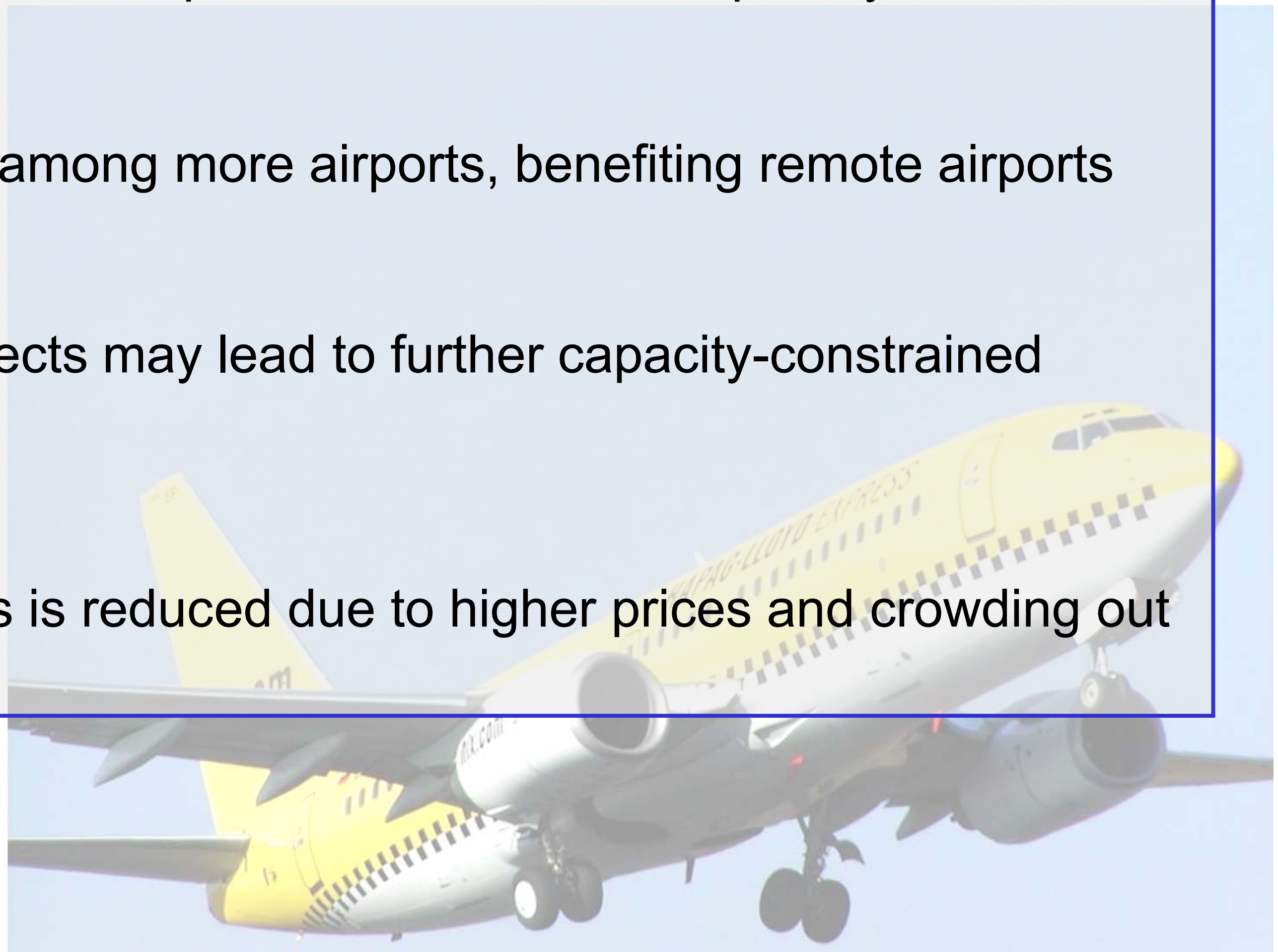
Conclusions

• Capacity constraints at one airport affect the whole airport system

• Demand is distributed among more airports, benefiting remote airports

• However, spill-over effects may lead to further capacity-constrained airports

• Welfare of air travellers is reduced due to higher prices and crowding out effects



Thank you for your attention

Contact:

Dr. Marc C. Gelhausen

DLR - German Aerospace Center

Institute of Air Transport and Airport Research

Linder Höhe

51147 Cologne/Germany

Marc.Gelhausen@dlr.de

Tel: +49 2203 601 2463

Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft