Measuring technical efficiency of German airports in the European context

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Outline

- Motivation
- Literature Review
- Data
- Methodology
  - → **Data Envelopment Analysis on Airside Side**
  - → **Tobit regression**
- Conclusion

Motivation

- Benchmarking initiatives
- Bad performance of German airports
- Factors influencing the efficiency of the airports

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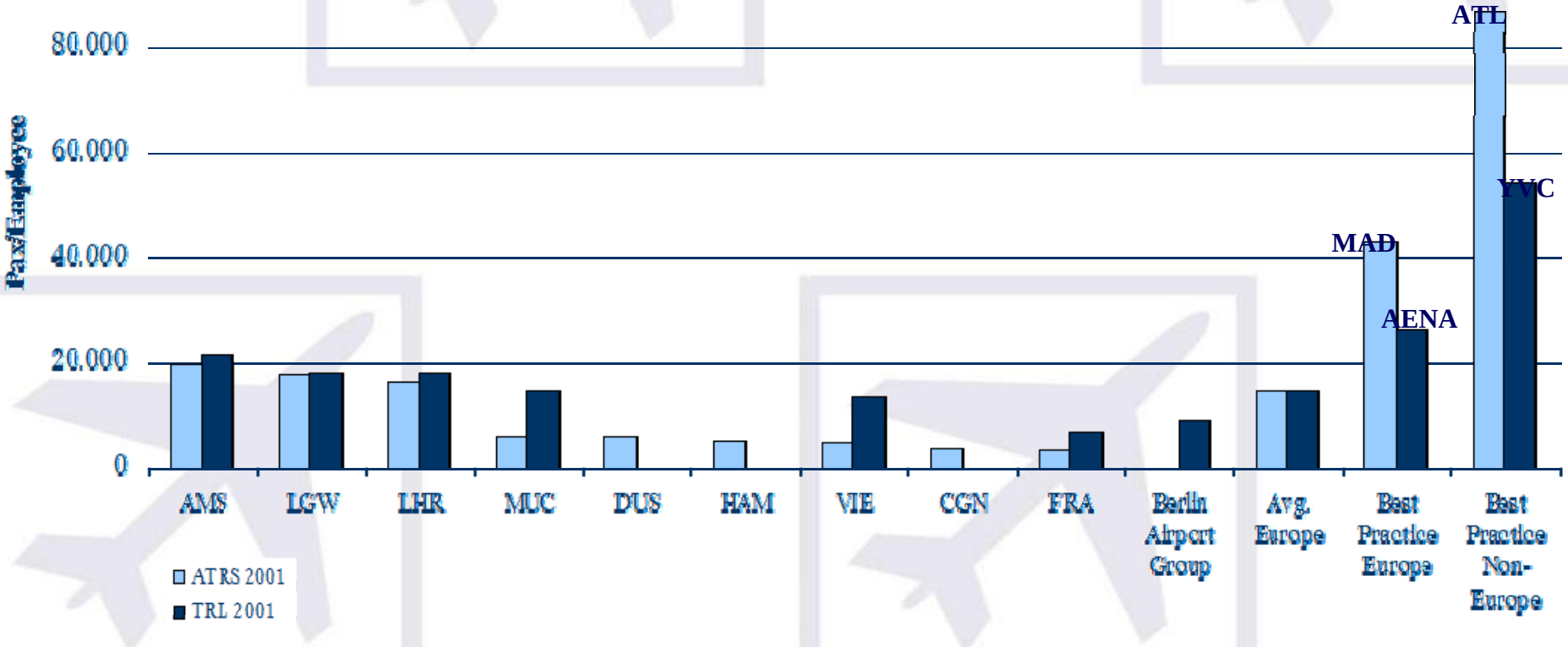
Aim: measuring efficiency and identifying the factors

Benchmarking of German airports: ATRS versus TRL

- Labor Productivity



Source: ATRS 2003, TRL 2003

ATRS versus TRL

✈Labor Productivity – Ranking Differences

	ATRS 2000	TRL 2000	
ARN	26.352	26.241	ARN
OSL	22.955	23.531	AMS
ZRH	22.249	22.627	ZRH
AMS	20.270	22.447	OSL
LGW	17.814	19.066	LHR
LHR	17.002	18.092	LGW
GVA	16.008	18.032	MUC
CPH	12.617	17.979	GVA
MAN	7.067	14.632	VIE
MUC	5.714	13.174	CPH
VIE	4.879	10.692	MAN
FRA	3.459	8.050	FRA

Difference (%)	
MUC	215,6%
VIE	199,9%
FRA	132,7%
MAN	51,3%
$\varnothing_{total}$	54,8%
$\varnothing_{Ground\ H.}$	119,8%
$\varnothing_{w/o\ GH}$	6,57%

Source: ATRS 2003
TRL 2002

Methods of ATRS and TRL

ATRS	TRL
Continental Comparison	Worldwide Comparison
Partial and Total Factor Productivity	Partial Performance Indicators
No Data Adjustment but Measurement of Residual Factor Productivity by Multiple Regressions	Data Adjustment by Identification of Core Activities

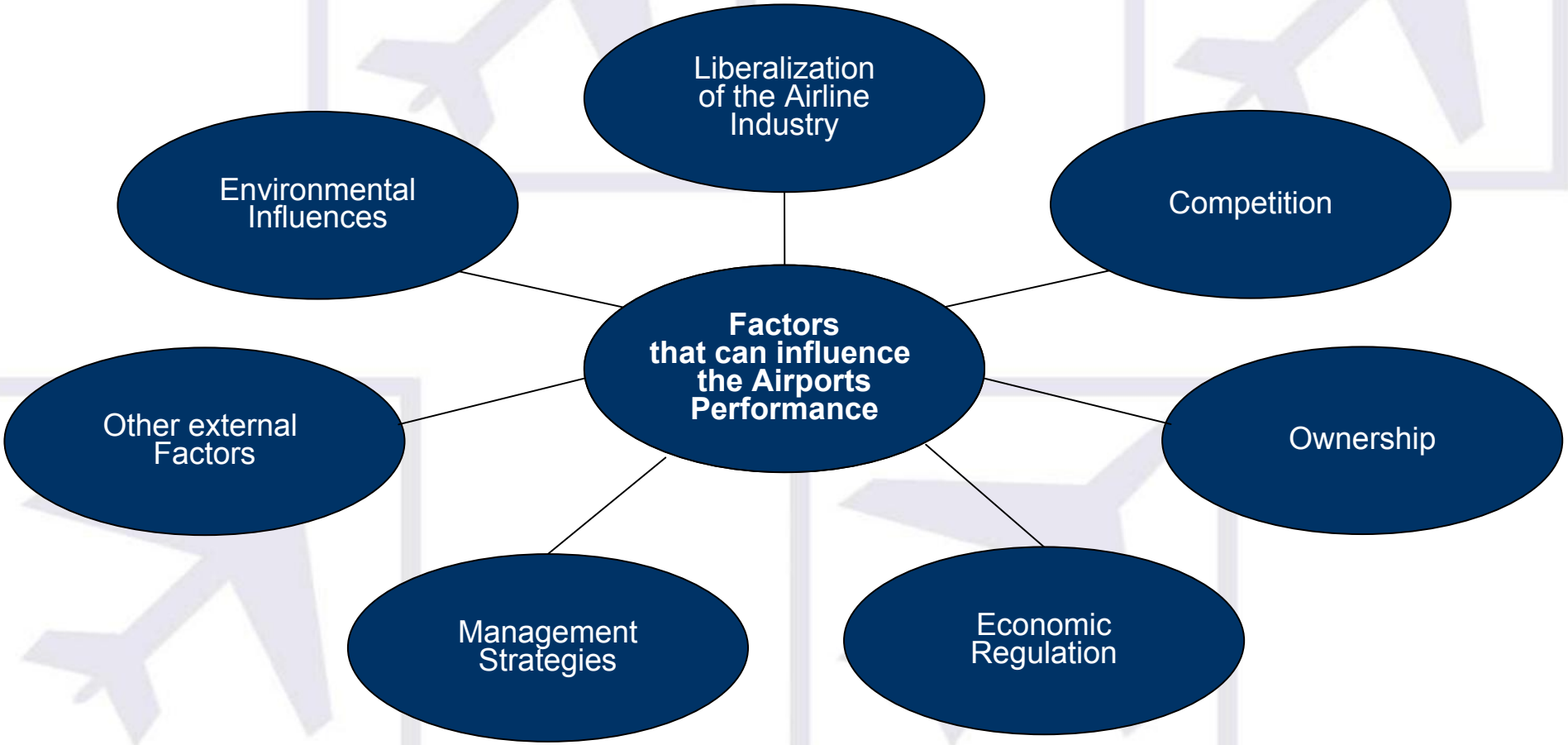
Literature overview I

Author	Airports	Time Frame	Focus	Inputs	Outputs	Conclusion/ Results
Gillen, D. and Lall, A. (1997)	23 of the top 30 US Airports	1989 - 1993	relative efficiency and second stage regression	Terminal Services (VRS assumed) => no of runways => no of gates => terminal area => no of employees => no of baggage collection belts => no of public parking spots Movement Model (CRS assumed) => airport area => no of runways => runways area => no of employees	Terminal Services => no of pax => pounds of cargo Movement Model => air carrier movements => commuter movements	high productivity for terminals does not imply a high productivity for airside production (movements) runway expansion reduces efficiency expanding gate capacity improve terminal services
Sarkis, J. (2000)	44 Major US Airports	1990 - 1994	operational efficiency	=> operational costs => no of airport employees => no of gates => no of runways	=> operational revenue => passenger flow => commercial movements => general aviation movement => total cargo transportation	hubs for major air carriers are more efficient airports not in snow belts are more efficient
Adler, N. and Berechman, J. (2001)	26 European Airports	-	relative efficiency and quality ranking	=> pax terminals, runways => distance to city centres => minimum connection times in minutes	=> Principal components obtained from a questionnaire on airlines	hypothesis that the quality of an airport has a strong effect on the airlines' choice of hubs has been supported
Fernandes, E. and Pacheco, R.R. (2002)	35 Domestic Brazilian Airports	1998	capacity efficiency	=> Airport surface area in m^2 => Departure lounge in m^2 => Number fo check-in-desks => curb frontage in metres => number of vehicle parking places => baggage-claim area in m^2	=> Domestic passengers	efficient Airports need to undertake capacity expansionsin the next years, inefficient ones in 20 years
Martín, J.C. and Román, C. (2001)	37 Spanish Airports (AENA)	1997	technical efficiency before privatisation process	=> labour expenditures => capital expenditures => material expenditures	=> air traffic movements => no of passengers => no of tons of cargo	Corporatization and privatisation might improve efficiency but airports need to be economically regulated
Pacheco, R.R. and Fernandes, E. (2003)	35 Brazilian Domestic Airports	1998	Managerial Efficiency	=> average no of employees => payroll, incl direct and indirect benefits => operating expenses	=> dom pax (in thousands) => cargo plus mail (in tons) => operating revenue => commercial revenue => other revenues, such as financial and miscellaneous rev	managerial efficiency vs. capacity efficiency

Literature review II

Author	Airports	Time Frame	Focus	Inputs	Outputs	Conclusion/ Results
Pels, E., Nijkamp, P. and Rietveld, P. (2001)	34 European Airports	1995 - 1997	relative inefficiency	Terminal Model: '=> Terminal Size (in sqm) => no of aircraft parking places at the terminal => no of remote aircraft parking places => no of check-in-desks => no of baggage-claim units Movement Model: => total airport area => total length of rw y => no of a/c parking positions at the terminal => no of remote a/c parking positions	Terminal Model => no of pax Movement Model => aircraft transport movement	most airport operate under IRS large deviations in relative efficiency among the airports airports w ith time restriction/ slot coordination seem to be less efficient(2003)
Sarkis, J. and Talluri, S. (2004)	44 Major US Airports	1990 - 1994	operational efficiency	=> operational costs => no of airport employees => no of gates => no of runw ays	=> operational revenue => passenger flow => commercial movements => general aviation movement => total cargo transportation	hub 'Airports' and geographical considerations affect airport eff11ficiencyg9
Oum and Yu(2004)	90 airports and 8 airport authorities w orldw ide	CGN, DUS, FRA, HAM, MUC in European Comparison	Productivity and Efficiency, Unit Costs and Cost Competitivene s, Financial Performance	=> No of employees => Expeses on purchased Goods, Materials and Services => No of RWYs => Total Terminal Size => No of gates	=> No of Pax => Cargo in Tonnes => ATM => Aeronautical and Non-Aeronautical Revenue	**Labour Productivity:**All German airports on the bottom of the table (on last 7 of 23 European airports) **Capital Productivity:** Except FRA all German airports w ith spare capacity **VFP and TFP:**below avg. results for German airports
Malighetti P., Martini G., Paleari S. and Redondi R.(2007)	27 Italian airports	2005,2006	Productivity Measurement (in various forms)	Terminal Model => Terminal Surface Area => no of aircraft parking places at terminal => no of aircraft transport movements => no of lines for baggage claims Movement Model => no of aircaft parking positions => Airport Surface Area => no of lines for baggage claim	Terminal Model => no of pax Movement Model => aircraft transport movement	30% are efficient, 74% of airports show increasing returns to scale, airport management is more efficient than italian economy

Identifying factors I



Identifying factors II

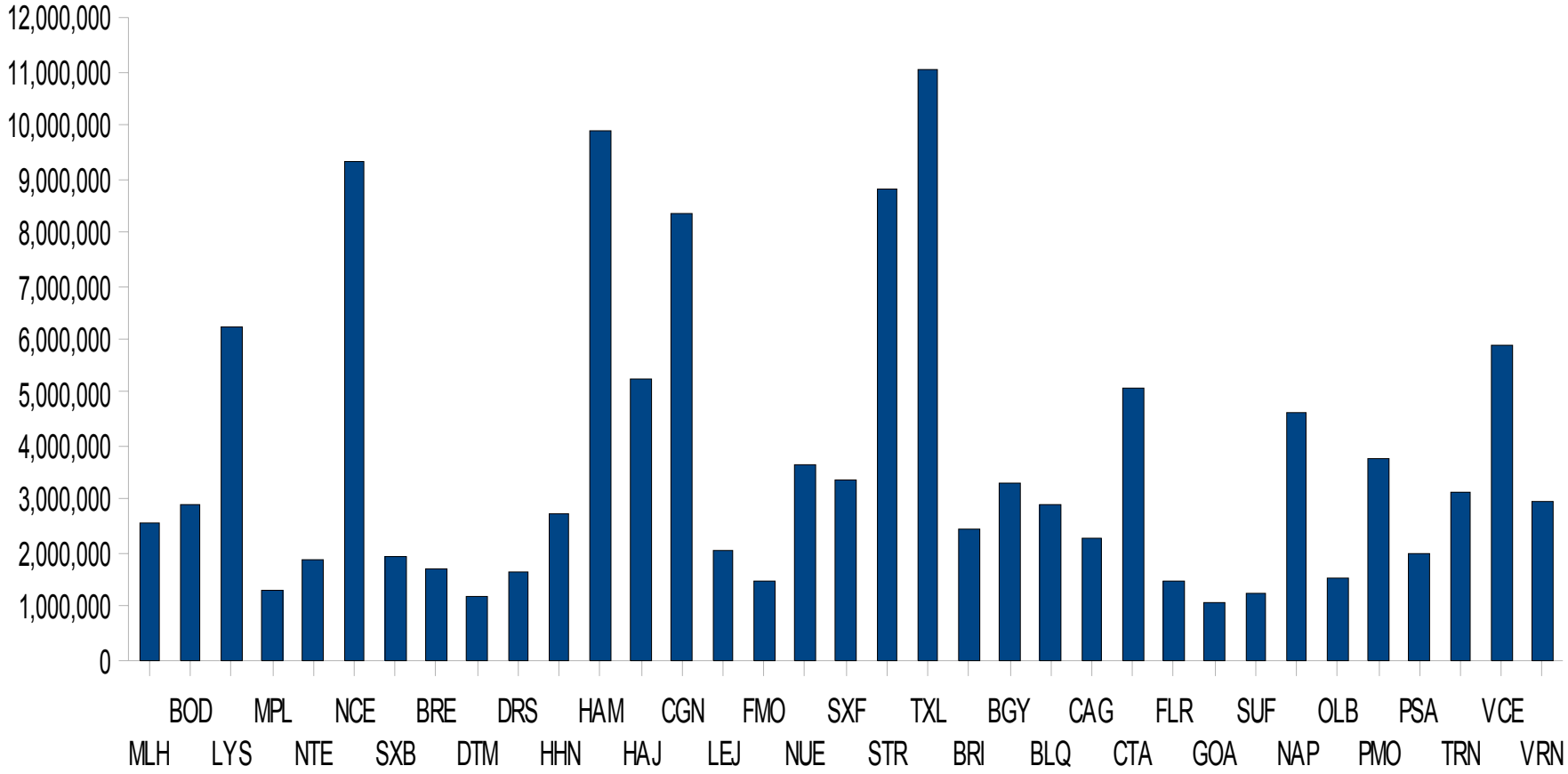
- **Gillen and Lall**(1997): expansion of gates, presence of hub airlines improve airside efficiency; increasing the number of runways reduces efficiency
- **Oum and Yu**(2004): airport size, capacity constraints, NA business impact positively productivity; international traffic reduces productivity
- **Lin and Hong**(2006): ownership, airport size, the existence of hub, location of airport, country's economic growth

Data I

France		Germany		Italy	
Basel-Mulhouse	MLH	Bremen	BRE	Bari&Brindisi	BRI
Bordeaux-Mérignac	BOD	Dortmund	DTM	Bergamo	BGY
Lyon	LYS	Dresden	DRS	Bologna	BLQ
Montpellier	MPL	Hahn	HHN	Cagliari	CAG
Nantes	NTE	Hamburg	HAM	Catania	CTA
Nice	NCE	Hanover	HAJ	Florence	FLR
Strasbourg	SXB	Cologne-Bonn	CGN	Genoa	GOA
		Leipzig	LEJ	Lamezia Terme	SUF
		Münster-Osnabrück	FMO	Naples	NAP
		Nürnberg	NUE	Olbia	OLB
		Berlin Schönefeld	SXF	Palermo	PMO
		Stuttgart	STR	Pisa	PSA
				Turin	TRN
				Venice	VCE
				Verona&Brescia	VRN

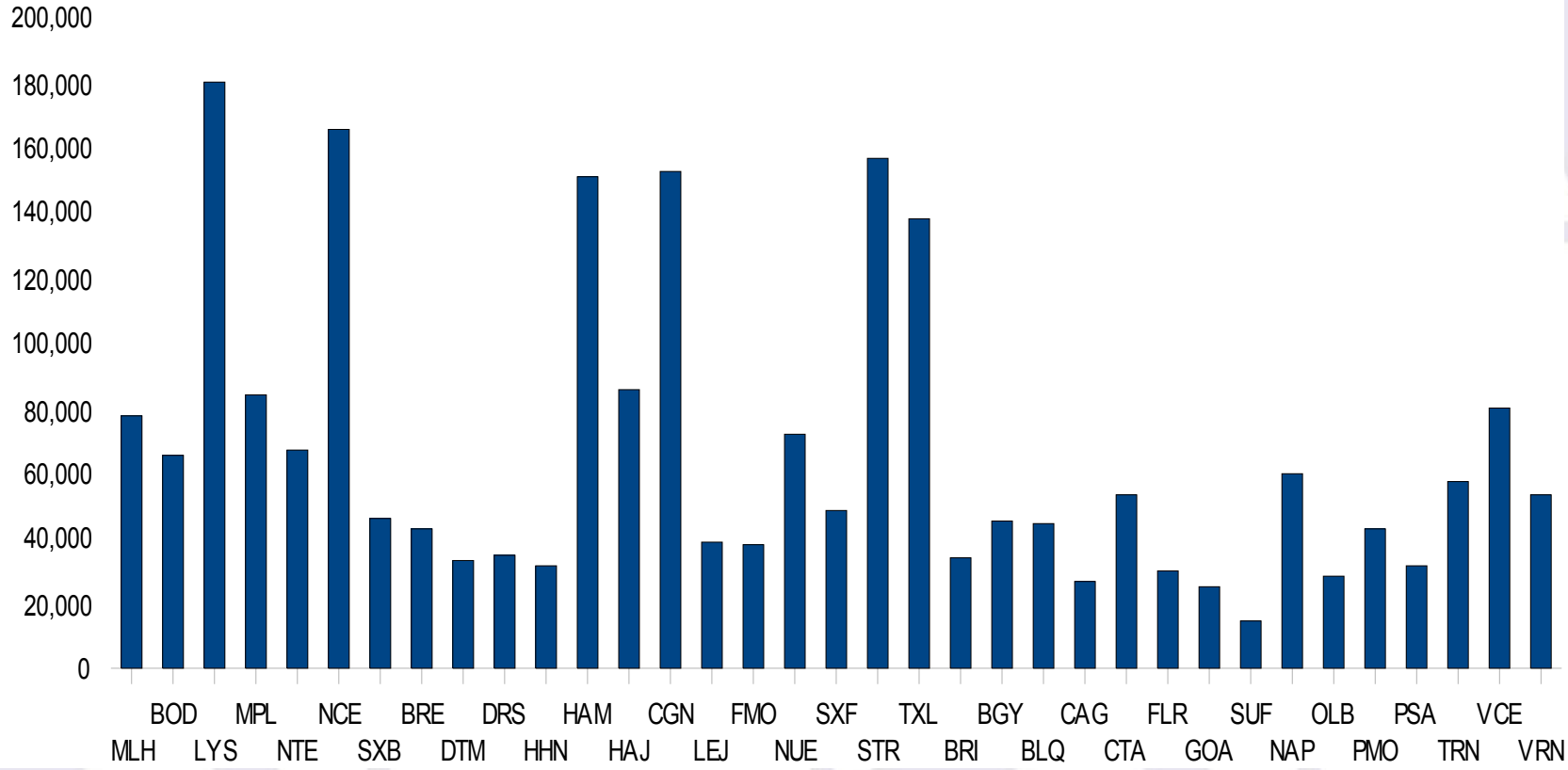
- Traffic and capacity data (2004)

Data II



Number of Passengers (2004)

Data III



Number of Air Transport Movements (2004)

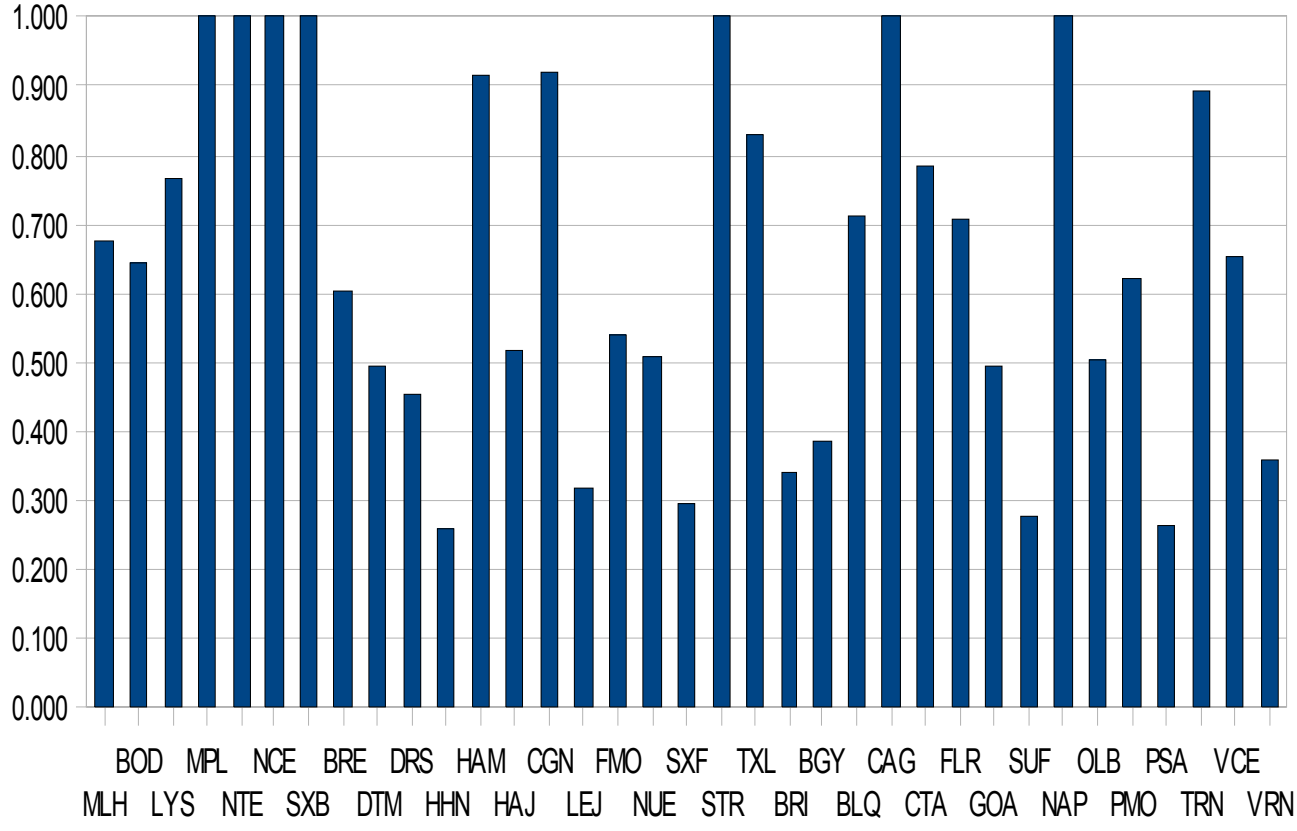
DEA methodology

- Input specification(1): airport area, number of runways, number of employees
- Input specification(2): airport area, runway area, number of runways
- Output specification: air transport movements

Capacity considerations

- NCE, HHN, BRI, LAM, TRN, VCE undertook capacity expansions (airport area) in last two years
- CGL and GOA decreased their capacity

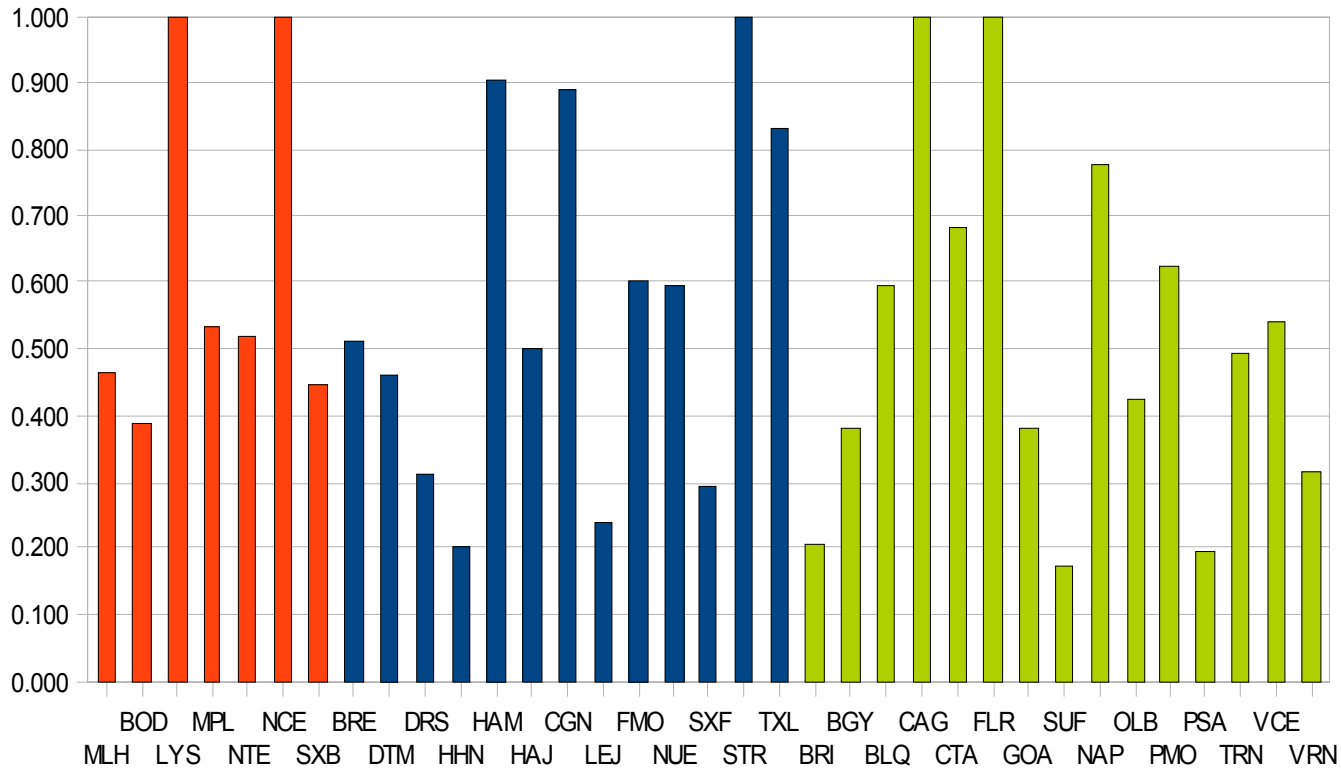
DEA results (1)



IATA	TE	Scale
MLH	0.675	drs
BOD	0.646	drs
LYS	0.766	drs
MPL	1.000	-
NTE	1.000	-
NCE	1.000	-
SXB	1.000	irs
BRE	0.602	irs
DTM	0.493	irs
DRS	0.453	irs
HHN	0.257	drs
HAM	0.914	drs
HAJ	0.516	drs
CGN	0.921	drs
LEJ	0.319	drs
FMO	0.539	irs
NUE	0.506	irs
SXF	0.293	drs
STR	1.000	-
TXL	0.832	drs
BRI	0.341	drs
BGY	0.387	irs
BLQ	0.713	irs
CAG	1.000	-
CTA	0.784	irs
FLR	0.706	irs
GOA	0.494	irs
SUF	0.278	irs
NAP	1.000	irs
OLB	0.502	irs
PMO	0.622	drs
PSA	0.265	irs
TRN	0.894	irs
VCE	0.654	irs
VRN	0.359	drs

- French airports outperform the German and Italian airports
- MPL,NTE, NCE, SXB, STU, CAG, NAP operate under 100% efficiency
- 50% of airports exhibit irs, whereas 37% show drs
- Mean efficiency for France(0.870), Germany(0.588), Italy(0.600)

DEA results (2)



IATA	TE	Scale
MLH	0.464	drs
BOD	0.390	drs
LYS	1.000	drs
MPL	0.532	drs
NTE	0.518	irs
NCE	1.000	-
SXB	0.445	irs
BRE	0.510	irs
DTM	0.461	irs
DRS	0.332	irs
HHN	0.201	-
HAM	0.904	drs
HAJ	0.501	drs
CGN	0.890	drs
LEJ	0.232	drs
FMO	0.600	irs
NUE	0.596	irs
SXF	0.290	drs
STR	1.000	-
TXL	0.834	drs
BRI	0.206	drs
BGY	0.380	irs
BLQ	0.594	irs
CAG	1.000	-
CTA	0.683	irs
FLR	1.000	irs
GOA	0.382	irs
SUF	0.172	irs
NAP	0.776	irs
OLB	0.425	irs
PMO	0.622	drs
PSA	0.196	-
TRN	0.492	irs
VCE	0.539	drs
VRN	0.317	drs

- LYS, NCE, STR, CAG, FLR form a frontier.
- 16 out of 34 airports operate under increasing returns to scale
- HHN,BRI, SUF and PSA could have served five times more ATMs
- Mean efficiency for France(0.621), Germany(0.564), Italy(0.519)

Tobit regression I

Variable	Coefficient	t-statistics
Number of runways	-.2065426	-3.46***
Airport area	-1.88e-08	-1.72**
WLUs	6.32e-08	5.29***
PAX/ATM	.000522	0.22
public	.1252227	1.26
private	.1480652	0.77
France	.2000746	2.25**
Italy	.0374901	0.46
constant	.419387	2.27**

***significant at 1%
**significant at 5%
*significant at 10%

Tobit regression II

Variable	Coefficient	t-statistics
Number of runways	-.2048714	-3.34***
Airport area	-2.36e-08	-2.18**
WLUs	6.33e-08	5.81***
France	.1994823	2.52**
constant	.5951353	7.66***

***significant at 1%
**significant at 5%
*significant at 10%

Conclusion

- French airports achieve higher efficiency
- Airports handling more passengers and cargo achieve
- Capacity expansions reduce the efficiency
- Privatization effects are insignificant
- Problems: sensitiveness of the DEA to the input-output combinations

Thank you for your atention