Measuring performance and profitability of regional European airports and implications for financial break even

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Measuring performance and profitability of regional European airports and implicatons for financial break even

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Introduction & Study objectives

- Small regional airports frequently suffer from insufficient revenues to cover their costs

  i.e necessary to subsidize loss-making airports

- Main questions:

- Up to what size? By how much?
- Has the break-even point shifted over the years?

Study objectives

- develop methodology to estimate relative efficiencies of regional airports
- analyze efficiency changes over time
- find out the minimum passenger output for financial viability
- examine reasons for poor performance
- provide policy recommendations

Critical Questions concerning financial break even:

- 1) which airports can finance their operating costs (OC) from their own revenue?
- 2) which airports can finance their operating and capital costs (OC+CC) from their own revenue?

Our data fromavinor study, being updated

- Timeframe: 2002-2011
- 102 airports from:
- Austria, France, Germany, Italy, Norway, Slovenia & UK
- Avinor (Norway) from our Avinor study (with 41 airports alone)
- All have < 1.6 mill. passengers p.a.
- 882 observations

Data available/
includes large airports that are not used here

State/airport operator	Number of airports	Available data
France	4 large, 29 small	1999-2009
Germany	12 international, 2 regional	1990-2010
Italy	18	2000-2010
UK (not including HIAL)	18 large, 5 small	2000-2010
Scotland (HIAL)	10	2002-2010
Iceland (Isavia)	11	2002-2010
Greenland (Mittarfeqarfiit)	4	2005-2011
Finland (Finavia)	25	Fragmented financial data for 5 only for 2007-2009
Sweden (incl. Swedavia)	14 (Swedavia), 21 regional	Fragmented data, 1998-2010
Others	12	2002-2010

Airport Traffic Data

Country / Group	# of Airports	#of Observs.	Passengers			Air Traffic Movements		
			Average	Min.	Max.	Average	Min.	Max.
Austria	1	9	917,184	795,063	1,008,330	18,294	16,318	20,096
Avinor	41	369	205,986	5,850	1,649,584	5,883	647	37,821
France	22	176	493,531	14,441	1,568,382	7,911	888	24,492
Germany	2	18	468,164	234,664	657,749	12,237	6,431	19,279
Greenland	4	30	122,273	50,518	268,732	6,757	4,476	9,638
HIAL	10	90	107,211	5,450	703,371	5,828	724	20,601
Iceland	11	99	74,401	**269**	471,372	3,797	**172**	22,590
Italy	5	40	757,502	49,932	**1,645,730**	8,630	1,936	14,646
Slovenia	1	9	1,268,468	872,966	1,676,821	27,596	18,135	36,842
UK	5	45	533,133	3,000	1,088,000	10,665	474	**52,000**
Total/Average	102	885	300,500			6,921		

Methodology:1) Data envelopment analysis

Data

- **Variables** (Airport observations)
- INPUTS - Staff costs, other costs, runway area
- OUTPUTS - Pax, Atm, Cargo

Results

Time trends

Second stage regression

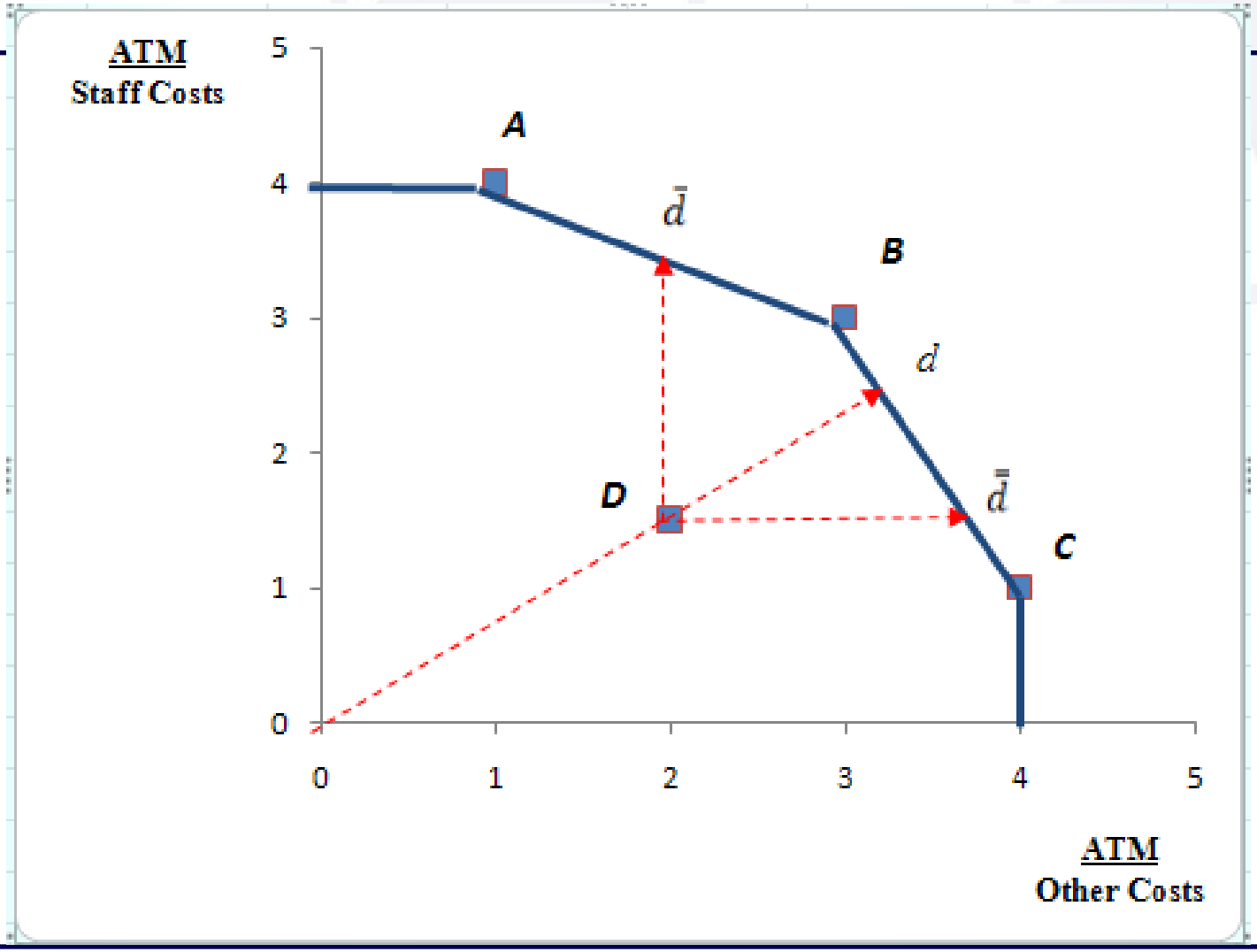
Break-even point

- Actually, estimation of break-even point is independent of the DEA approach
- (Unless we also want to show: "What would the break-even be, if the airports were all efficient")

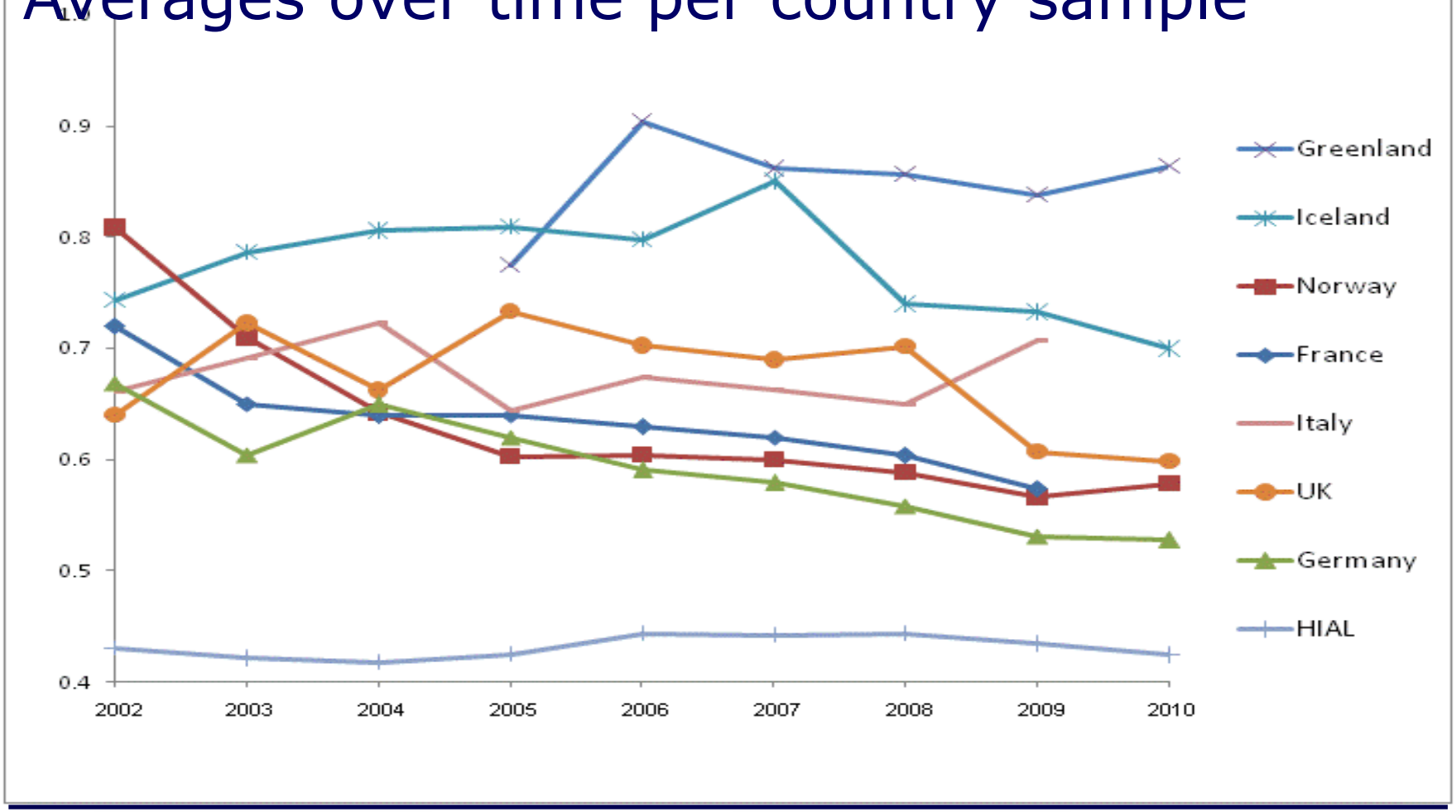
Variables for DEA

- Inputs:
  - labor costs
  - other operating costs
  - declared runway capacity for large airports
  - total runway length for small airports
  - (that means we don't have a good measure for capital, especially for small airports)
- Outputs:
  - the number of passengers served
  - commercial air traffic movements
  - tons of cargo
  - non-aeronautical revenues

DEA-Frontier visualization



Small Airport Efficiency DEA based: Averages over time per country sample



Efficiency Averages over Time per country sample

- Using DEA analysis, we try to find the best performing airports as benchmarks (they have the value of 1)
- Then we group to airports by country. No country reaches the value of 1.
- The ranking according to best performance are Greenland (but data problems), Iceland, UK, France, Norway and Germany.

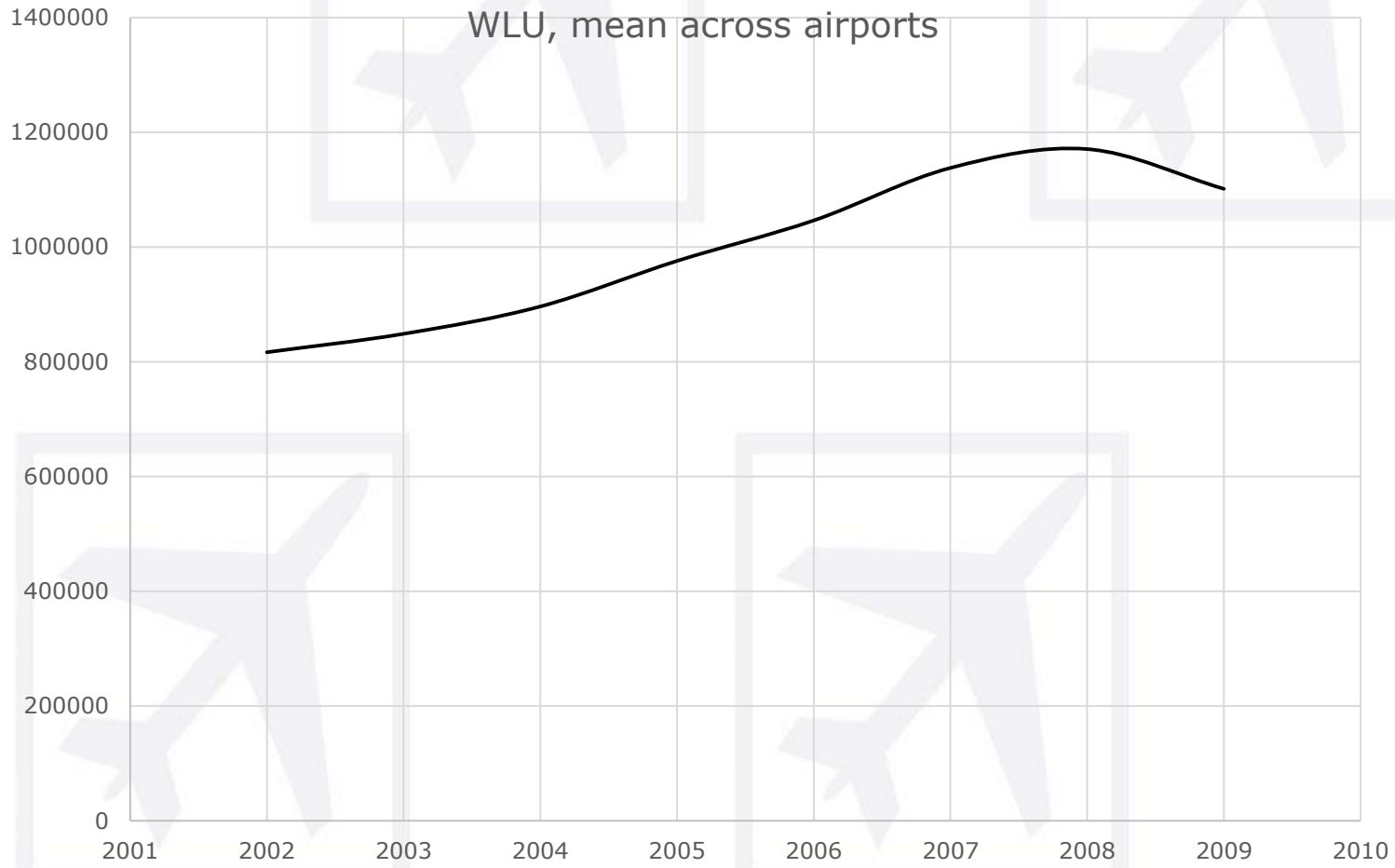
Efficiency Averages over Time per country sample:2

- The small Scottish airports are the worst performers, but also German airports do badly (but only used 2 airports in the sample)
- We have to be careful about over-interpreting Greenland's performance, because their airports receive some revenues for overflights, which make them not really representative.

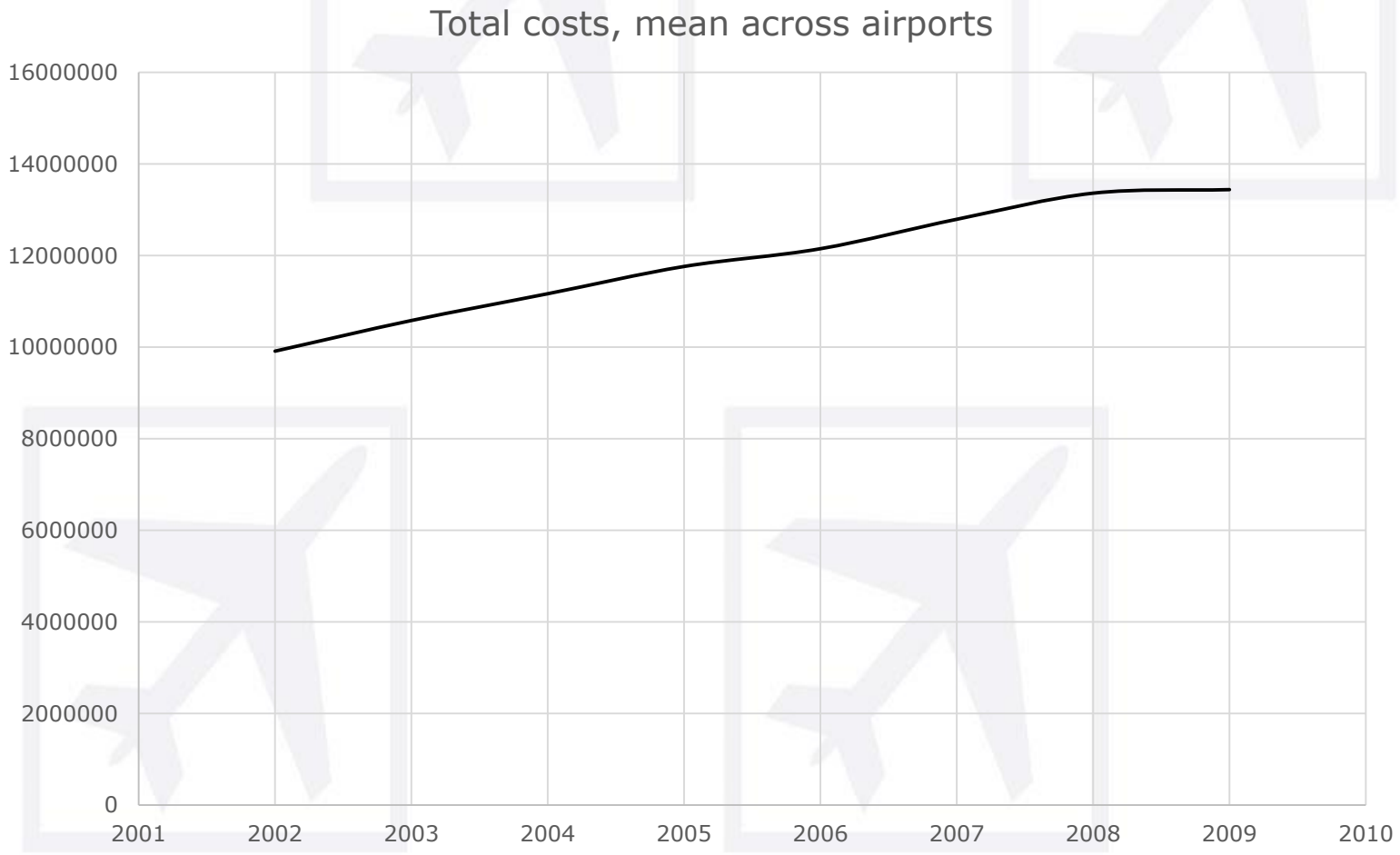
Efficiency Averages over Time per country sample:3

- Performance of Iceland airports is indeed surprising, but the effects of the economic recession starting in 2007 reduced volumes and thereafter lowered productivity.
- In general, we notice a downward trend for almost all the airports, especially for airports in Germany and France

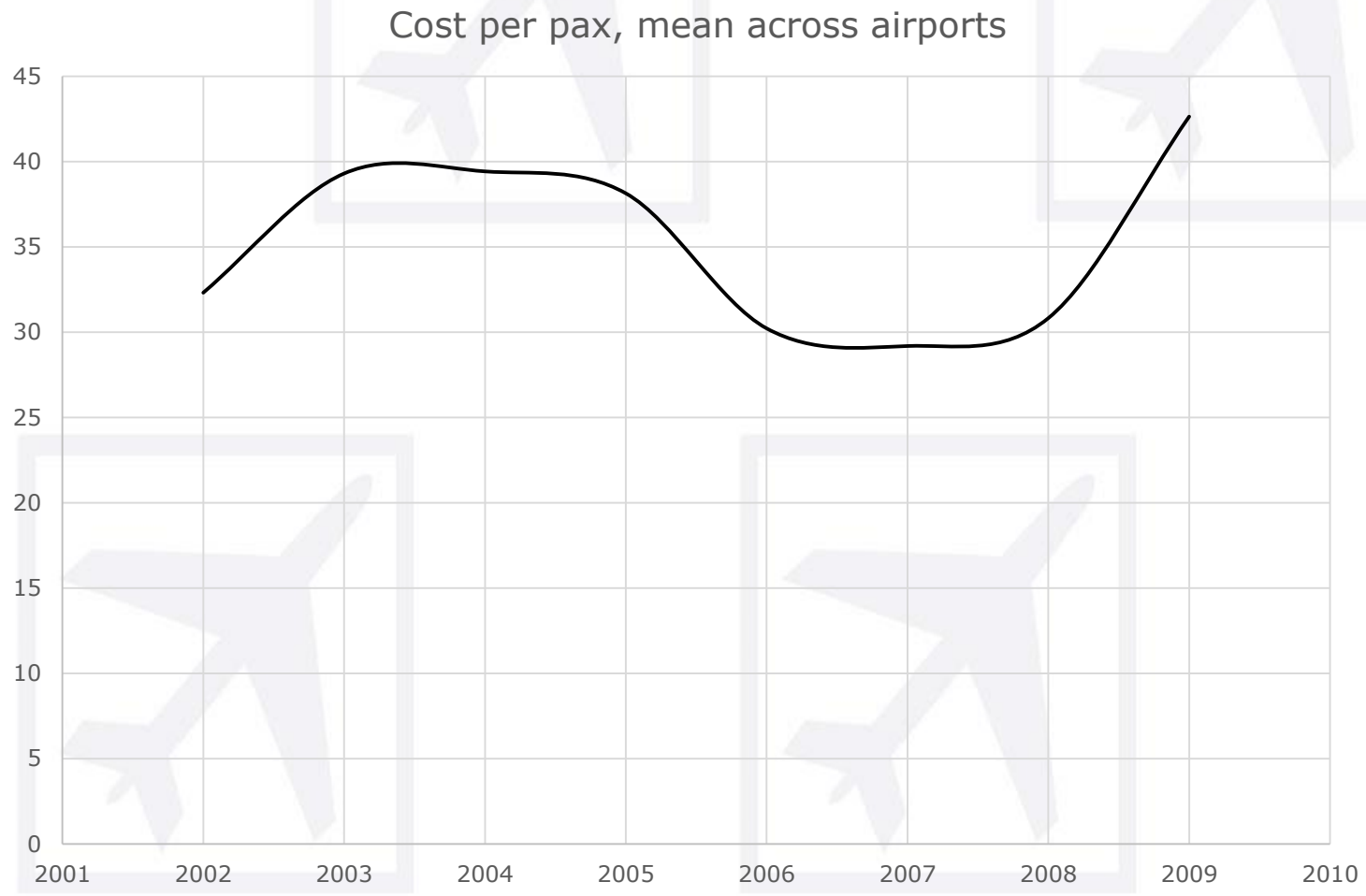
Trying to understand the data



Trying to understand the data

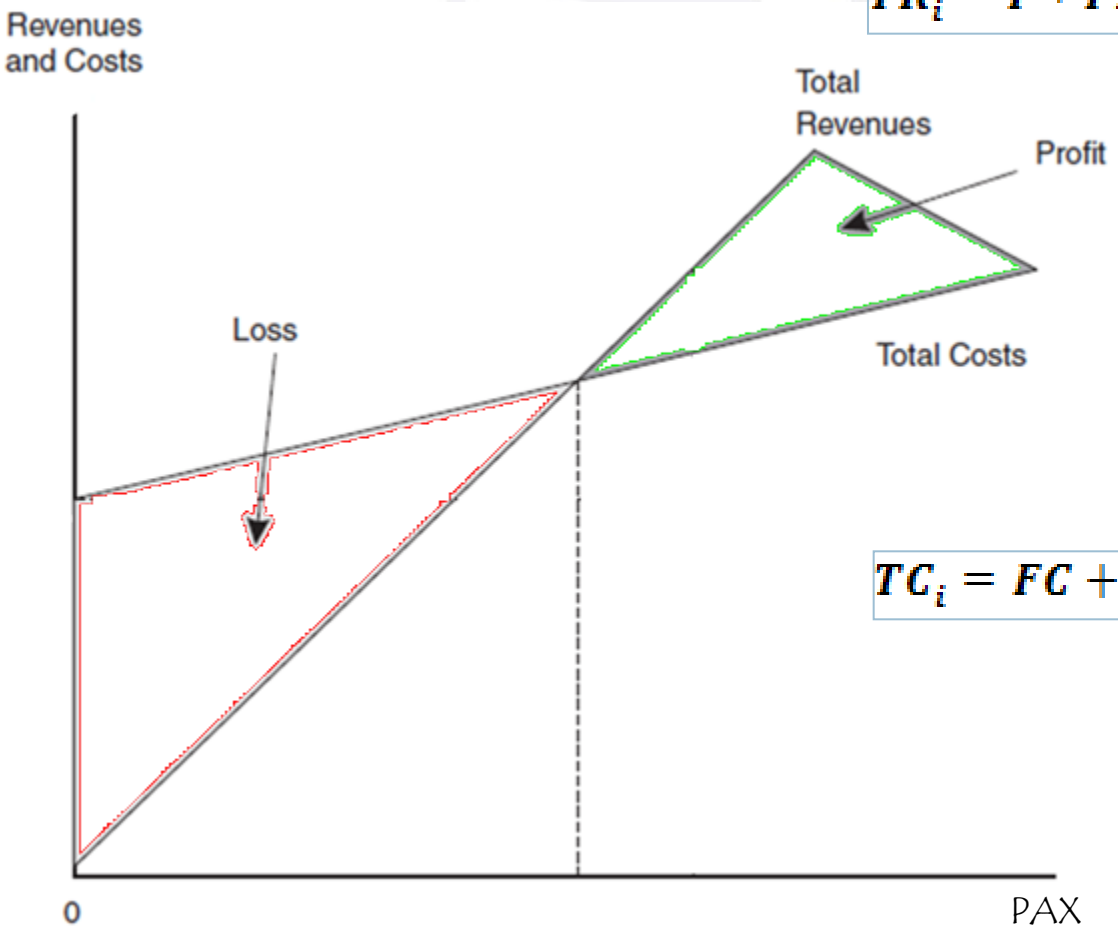


What happened to costs?



Methodology:3) determination of break-even point with revenue/cost function

$$TR_i = P * PAX_i + u_i \qquad \forall \quad i = 1, \dots, n$$



$$TC_i = FC + VC * PAX_i + e_i \quad \forall \quad i = 1, \dots, n$$

break-even point computation

	Regression results for total costs and revenues		Regression results for total costs and revenues for hypothetical efficient airports	
	Coefficient	t-Stat.	Coefficient	t-Stat.
2002				
Fixed cost	1,545,679	2.8328	837,420	1.6184
Variable cost	11.86	9.90	11.10	9.7765
Revenue	15.18	15.47	15.21	15.4733
2009				
Fixed cost	2,832,717	5.8987	1,438,292	5.8987
Variable cost	12.98	15.47	12.14	15.4719
Revenue	15.05	21.04	15.50	21.0492

	Critical level of passenger throughput	
2002	465,000	203,000
2009	1,300,000	427,000

Determination of break-even point using DEA

- Operational costs were increasing across Europe over last decade

- The estimated break-even point increased from 465,000 pax in 2002 to 1,300,000 pax in 2009

Further work

- Translog cost function – early stage
  - Should be able to obtain more information about economies of scale, scope, and capacity utilisation
  - Calculate price elasticity of input demand: if wages increase, what will be the employment effect on airports?
  - Better estimates of the breakeven point
- Evaluating the relationship between airport operations and regional development – in plans, depending on data

Translog cost – wish list

- Need better data:
  - FTE
  - Cost of capital
  - Capacity
- Benefit for ACI – sophisticated studies that can be used in your work

SFA - Translog function – early stage results

- **Input variables x_{itj}** (all values are loged and normalized as ln($INPUT_{itk}$)- average$_j$ (ln($INPUT_{itj}$)) are:
- PAX (lnpax)
- ATM (lnatm)
- Total Runway Length (lntr)
- **Output Y_{tj}**: Total revenue/Total costs as function lnTRTC =ln(total revenue)-ln(total costs+depreciation) which measures the costs range which can be covered by revenues from the airport operations

SFA - Translog function – early stage results

- The first step is a calculation of technical efficiency, where each airport (IATA) in each time period is treated as one DMU (Decision making unit) and frontier analysis is done. SFA results are given in Table 1

SFA - Translog function – early stage results

- new SFA analysis with normalized data (ln(Total revenue)-ln(Totalcost))
- results are much better, but there are still big jumps, especially in scale efficiency.
- The airports colored in yellow (sheet data) are ones with big efficiency oscillation
- (average changes less than -50% and greater than 50%).

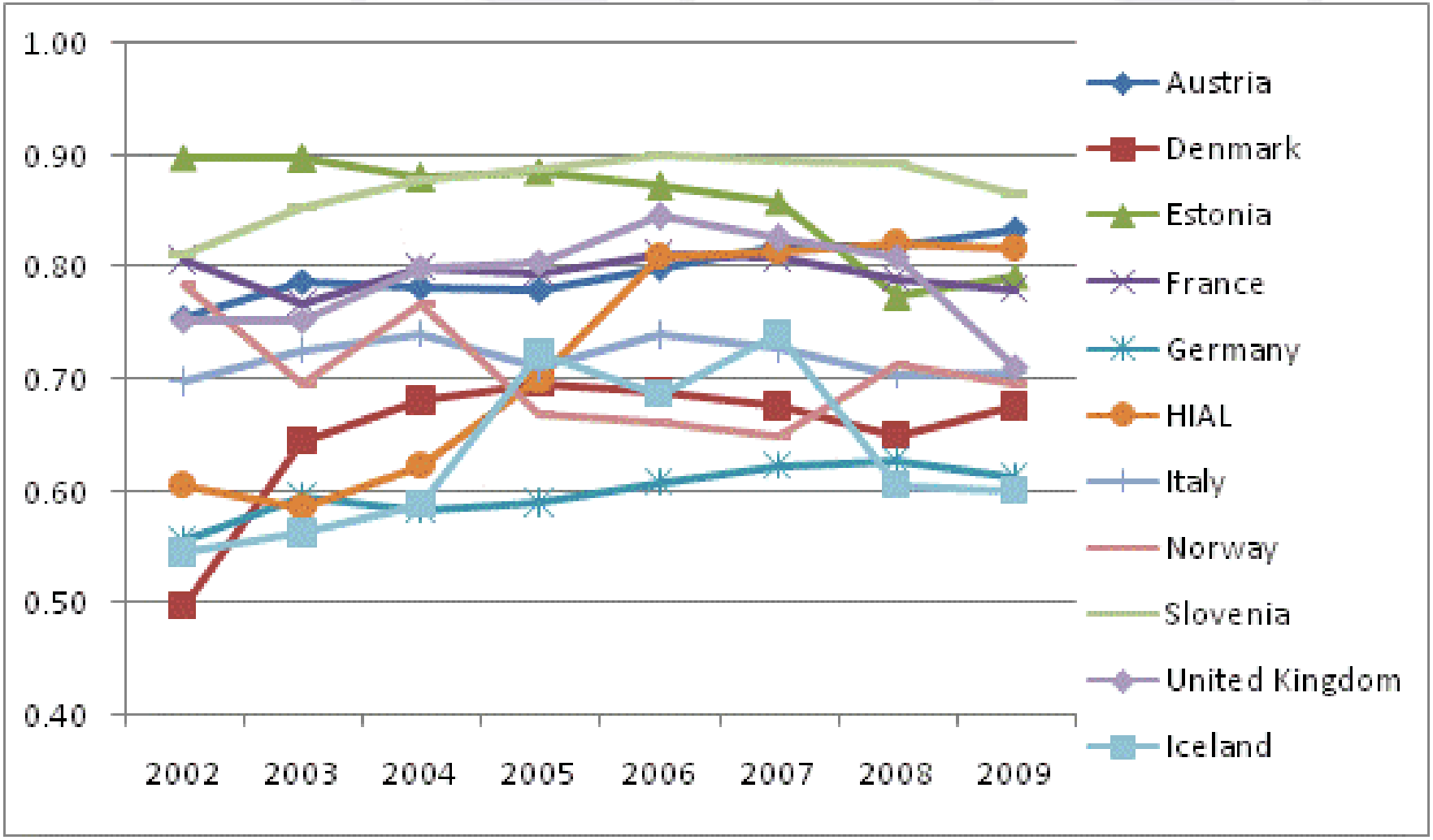
SFA - Translog function – early stage results

- SFA analysis is done on classical translog function with adjusted time variable (model 1), and on
- translog function with adjusted time variable and countries as dummy variables (model 2). Both options are good.
- third option with time as dummy variable is not presented because we do not have possibility to calculate TFP component which is directly dependent on time.

SFA -Translog function – early stage results

Year	Austria	Denmark	Estonia	France	Germany	HIAL	Italy	Norway	Slovenia	United Kingdom	Iceland	Grand Total
2002	0.7559	0.4971	0.8986	0.8054	0.5566	0.6053	0.6977	0.7840	0.8119	0.7521	0.5450	0.7264
2003	0.7864	0.6441	0.8969	0.7674	0.5954	0.5849	0.7263	0.6966	0.8531	0.7526	0.5624	0.6939
2004	0.7824	0.6805	0.8794	0.7988	0.5834	0.6221	0.7403	0.7670	0.8787	0.7994	0.5879	0.7336
2005	0.7795	0.6960	0.8853	0.7950	0.5892	0.6995	0.7095	0.6684	0.8888	0.8048	0.7222	0.7129
2006	0.7996	0.6890	0.8722	0.8103	0.6068	0.8092	0.7395	0.6612	0.9001	0.8451	0.6868	0.7252
2007	0.8190	0.6749	0.8584	0.8078	0.6228	0.8138	0.7271	0.6487	0.8950	0.8254	0.7392	0.7246
2008	0.8186	0.6500	0.7736	0.7891	0.6278	0.8206	0.7041	0.7128	0.8921	0.8085	0.6052	0.7282
2009	0.8344	0.6755	0.7919	0.7805	0.6132	0.8159	0.7052	0.6967	0.8663	0.7112	0.6009	0.7176
Grand Total	**0.7970**	**0.6509**	**0.8570**	**0.7943**	**0.5994**	**0.7214**	**0.7187**	**0.7044**	**0.8732**	**0.7874**	**0.6312**	**0.7203**

SFA - Translog function – early stage results



SFA - Translog function – early stage results

- These results are used for calculation of productivity changes form one year to another
  1. Technical efficiency change factor (TE) shows changing the efficiency form period *t* to *t*+1 assuming constant return to scale.
  2. Technological progress or change (TP or TC) shows how would unit perform in changing conditions (observing unit from period *t* is compared to units from period *t*+1 and *vice versa*).
- Therefore simple TFP=TE XTP.

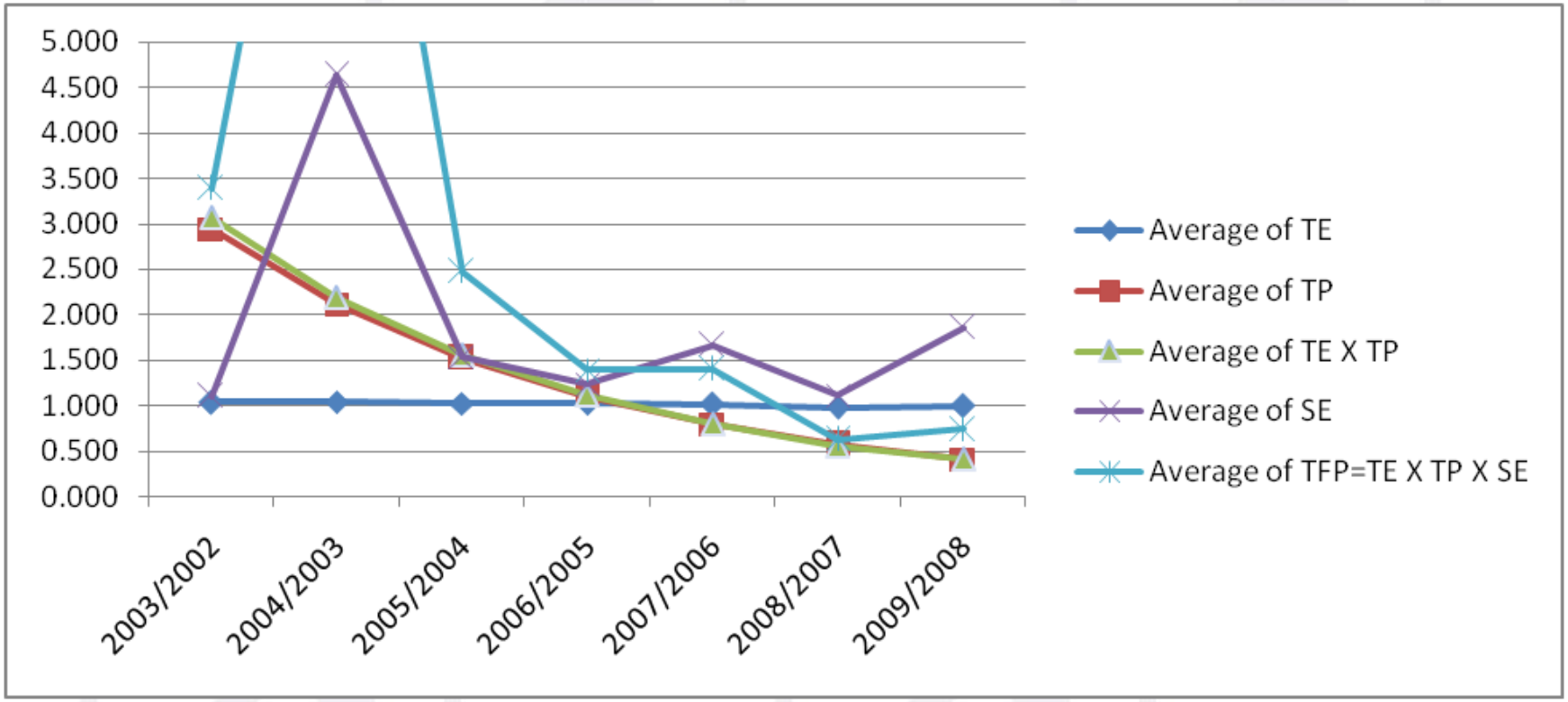
SFA - Translog function – early stage results

- Additionally, a scale efficiency SE is included to avoid the bias of constant return to scale (CRS)
- Average scale efficiency coefficient is less than 1
- Therefore

  TFP= TE X TP X SE

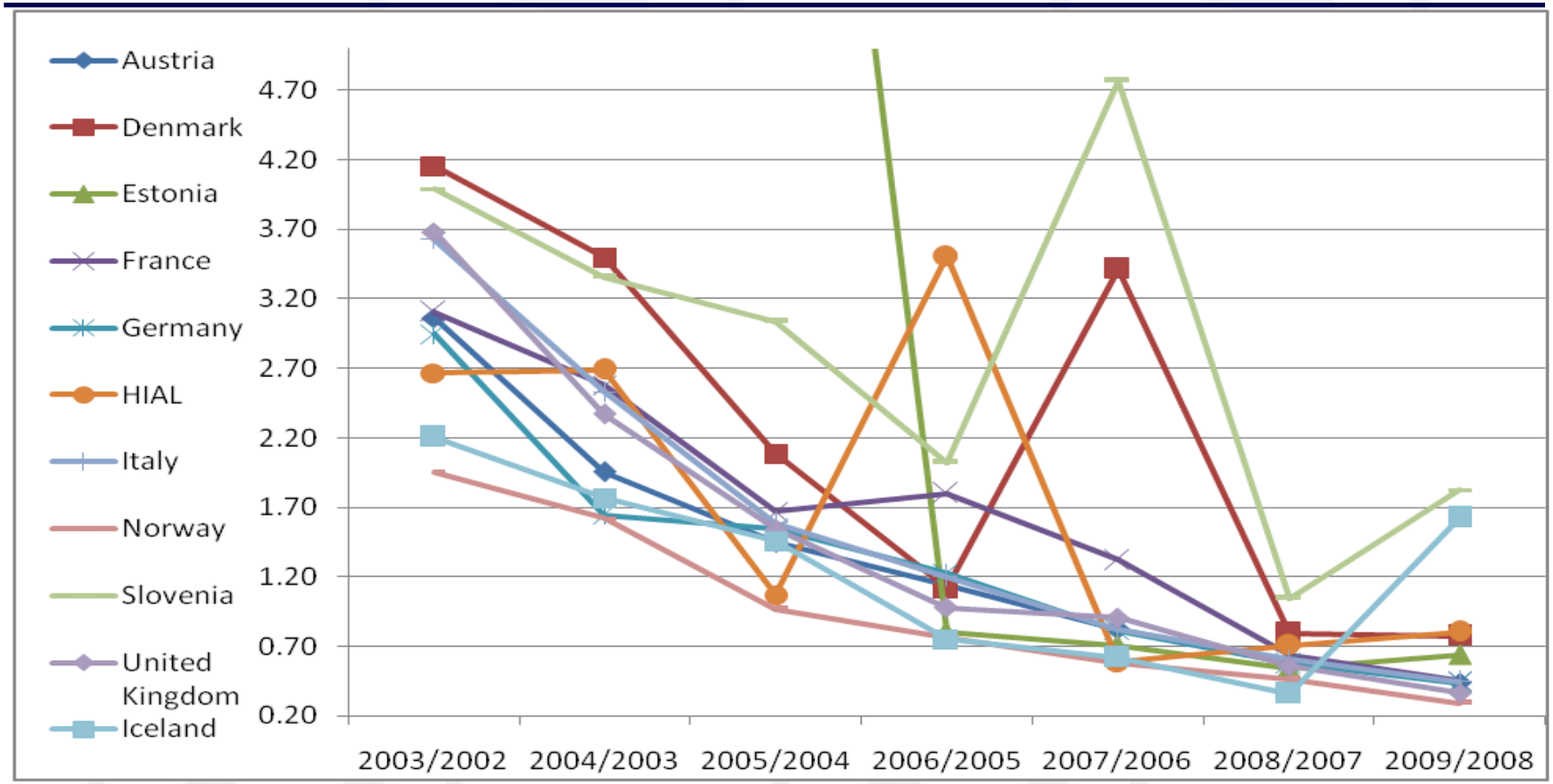
  (TFPC=TEC X TC X SEC).

SFA - Translog function – early stage results



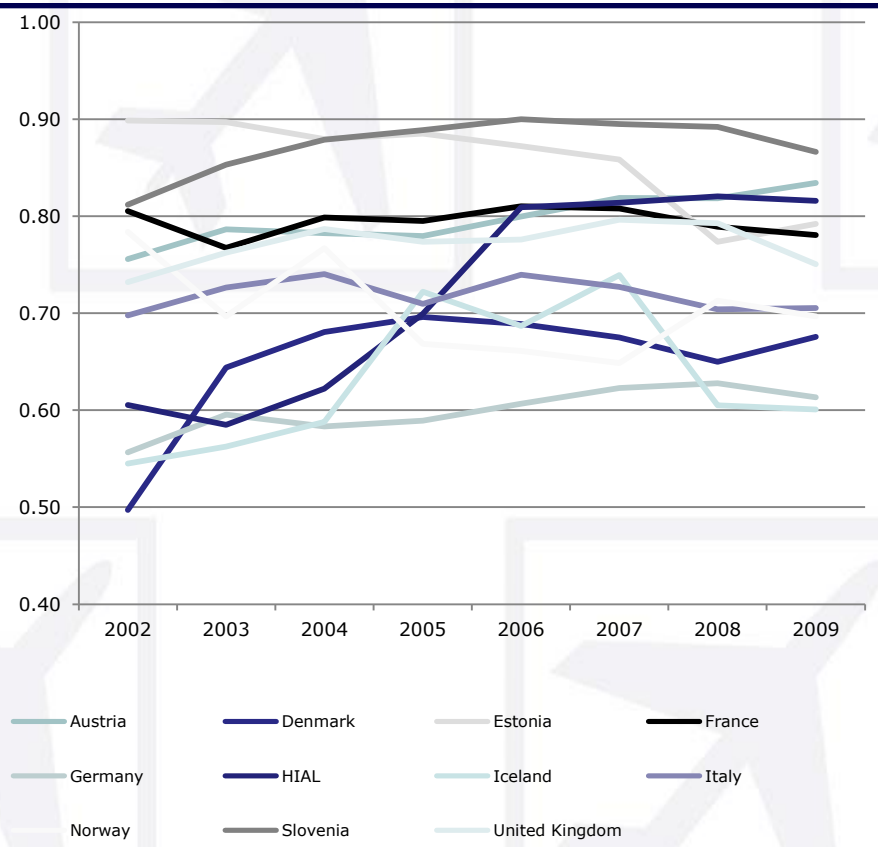
- Huge jump in scale efficiency (SE) due to one airport from Estonia and one from Iceland with SE>40 (need further examination)

SFA – Translog function – early stage results

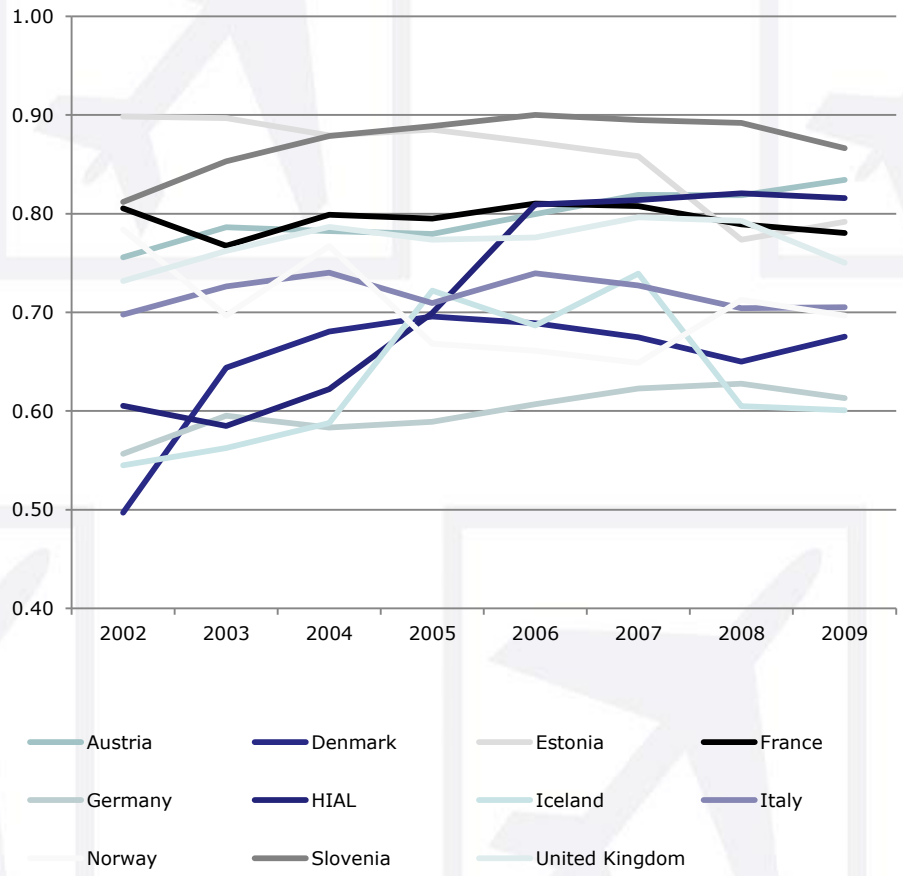


Interesting conclusion us that Denmark exhibits constant variation in the level of TFP changes, but it exhibits constant variation in TE changes too. On the other hand, most of the countries had constant exhibits constant changes with slight variations. The exceptions are Estonia and HIAL and Slovenia with variation in SE.

SFA – Translog function – Figure 1a) Results model 1



SFA – Translog function – Figure 1a) Results model 2



SFA - Translog cost – first estimates

- Cost elasticity with respect to passenger traffic is about five times that for cargo
- Clear economies of scope for passenger and cargo traffic
- First estimates of input demand elasticity with respect to staff price (imperfectly measured)
- Clear evidence of cost increases post-2006
- Economies of runway utilisation
- Very good fit: R-squared 0.998

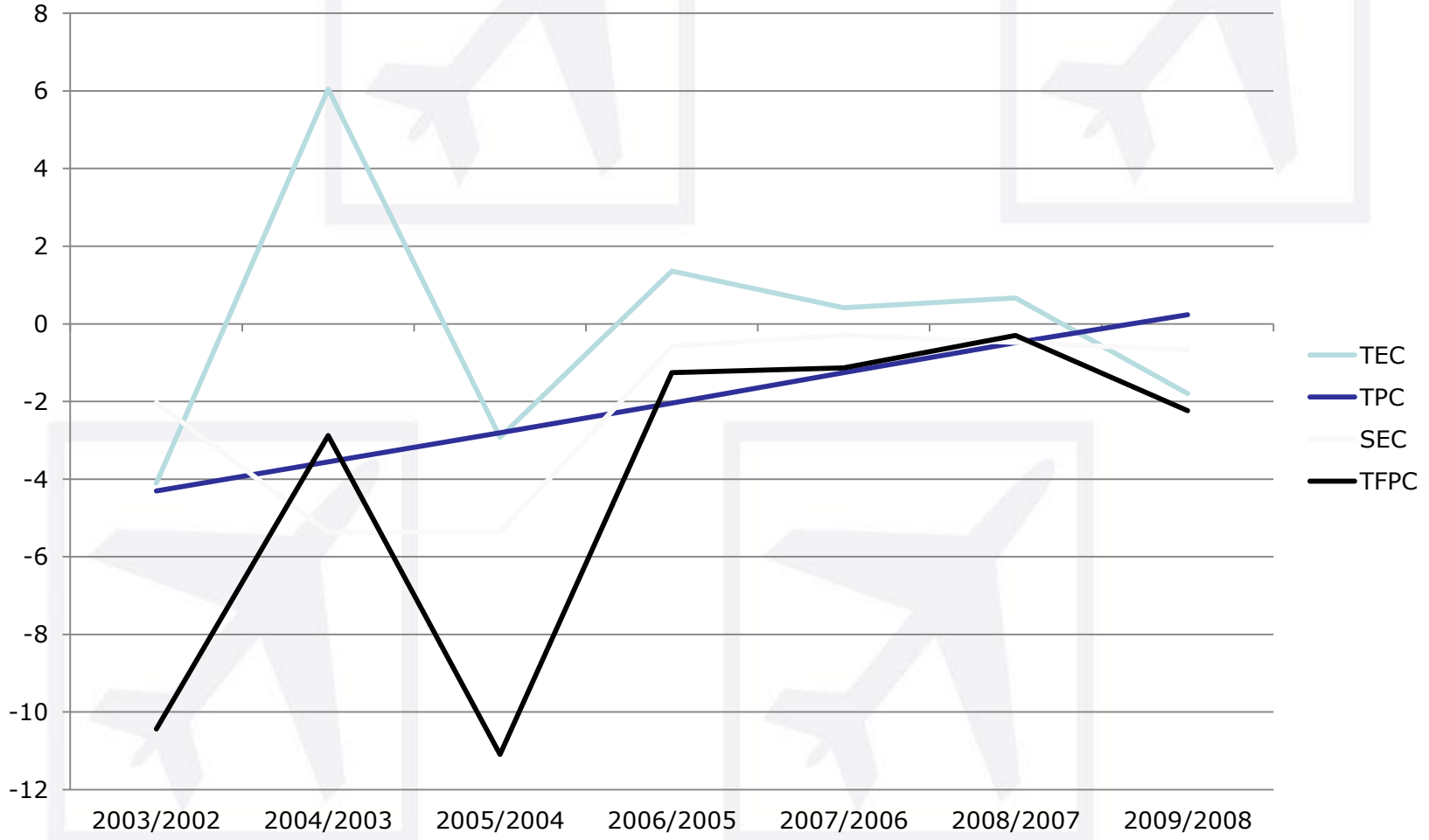
SFA - Translog cost – new estimates

- An average efficiency oscillate around 0.7.
- The best performers are Slovenia and Estonia (with one airport), followed by Austria (2 airports), France with 29 and UK with 14 small airports.
- The worst performers are airports in the Germany.
- Average sample efficiency is under 0.9 over the time period 2003-2009.
- The best overall performance (0.6996) is achieved in 2003 with slight variation afterwards.

SFA - Translog cost – new estimates cont

- Calculate the percentage of Total Factor Productivity index changes (TFPC) and it decomposition on
- Technical efficiency changes (TEC), Technological Progress (TP) and
- Scale Efficiency Changes (SEC) for each airport and each pair of figure 2 exhibits the trend of average changes in TFP index and its components

SFA - Translog cost – new estimates cont (trend of average changes in TFP index and its components



SFA - Translog cost – new estimates cont

- We can conclude that TFPC is quite stochastic, mainly following the stochastic curve of technical efficiency changes.
- TEC has one sort positive jump from 2003 to 2004 (10.15%)
- and negative jump in 2005 compared to 2004 (-9.4)
- This has a direct effect on TFPC. which has been positively changed for 10.15%

SFA – Translog function – early stage results

Next steps:

- Resolving input/output problems
- Efficiency comparison over time with varying decay SFA model
- Further analysis and comparison of scale efficiency and elasticity.
- Making correlations between efficiency, productivity and inputs.

Methodology:3) Financial analysis

- Financial and operational data from 139 European airports in 10 countries was collected for the years 2002 to 2010.
- For reasons of comparability financial data is deflated to a reference price level, currency and point in time

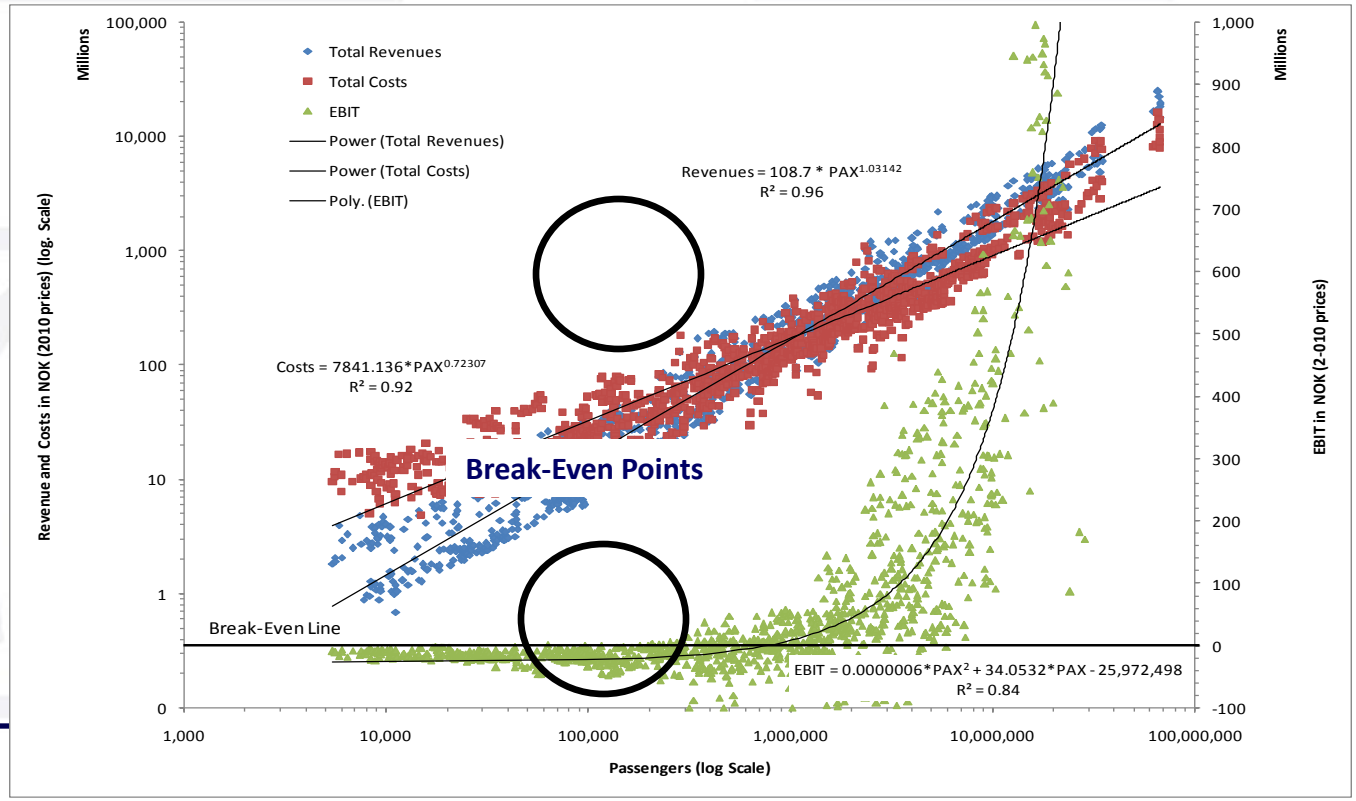
Data Requirements

- The data requirements are:
- passenger demand (pax) and
- profits or deficits (i.e. earnings before interests and taxes (EBIT)).
- EBIT

  = Revenues – Costs – Depreciation, which means capital costs are included.

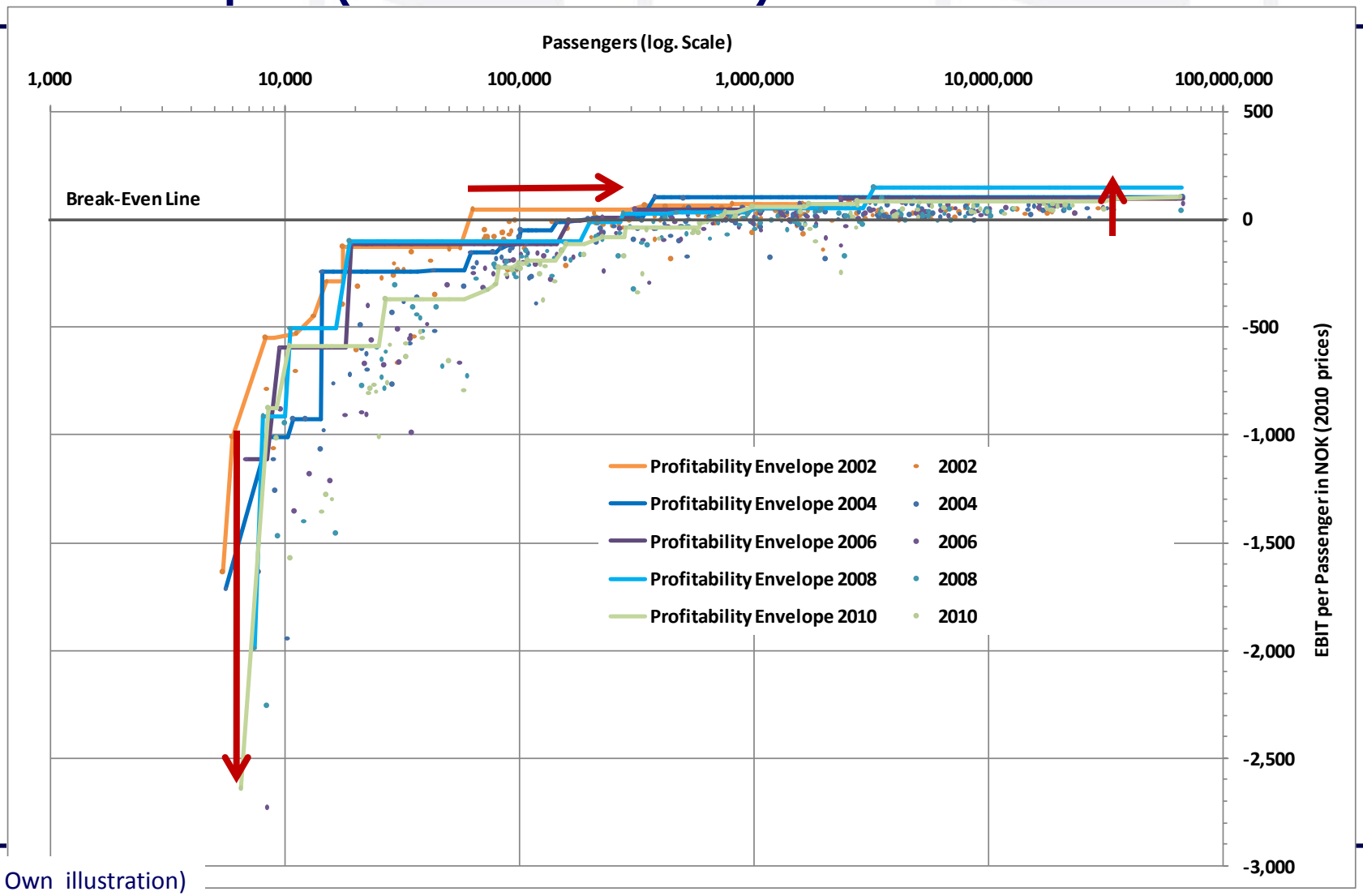
Data Description: Revenues, Costs (log scale) and EBIT

- Trends for 139 European airports over 9 years (2002 to 2010*) *except for Italy & France until 2009
- Break-Even Point on average at about 800.000 to 1 Mio. PAX per year



(Source: Own illustration)

Europe: Annual Profitability Envelope (2002-2010)

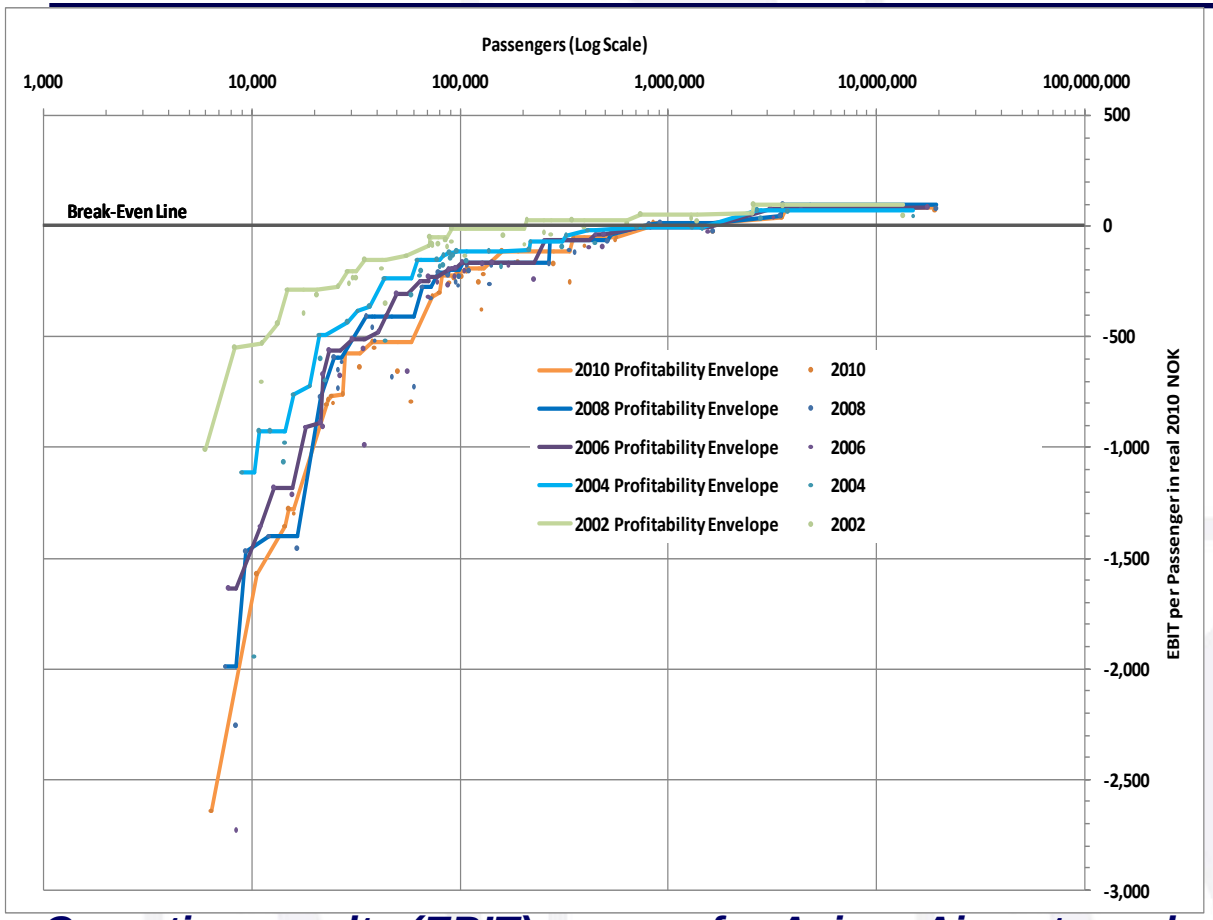


(Source: Own illustration)

Shift of curve over time:

1. Lower end (small airports) shifts downwards, become less profitable
2. Break-even point shifts right from 0.2mill. to above 1mill pax (but not very precise)
3. Upper end (large airports) seem to become more profitable, envelope shifts upwards

Financial performance of Avinor airports as EBIT per pax



Operating results (EBIT) per pax for Avinor Airports and profitability envelopes

- Profitability envelope for has been shifting down
- Breakeven point moved from 0.2 to 0.8 million pax
- Lower profitability leads to increased cross- subsidies

Results

- This very detailed data analysis has given us some interesting insights on:
- What is the 'critical size' at which airports can finance their operating and capital costs from their own revenue?
- One should treat the results with care, due to methodological and data

Results 2

- The DEA analysis is certainly a more sophisticated approach and has showed us some interesting results.
- The financial analysis using a frontier approach without real statistical tools give us only some first indication, which need to be checked further.

Results 3

- But the results also depend very much on the data.
- The data is not very clear on capital costs.
- Still, we can say that the critical size seems to be around 1,000,000 pax/p.a.years 2009/10.

Results 4

- The critical size has shifted over time from about 0.5mill pax p.a
- We don't know exactly why this shift has occurred.
- Going back to some of the country data might provide us with more answers
- That critical size is much higher than what is allowed by the EU Commission 2012 SGEI decision

Further analysis

- Post 2010 trend for decreasing operating costs – append new data, see what changes
- More sophisticated work needed
- Where is the breakeven point now?
- Are things different for airports with seasonal traffic?
- Ultimately, should EU apply one size fits all approach, or make decisions on case by case basis?

High number of small airports

~60 % of airports serve less than 1 million passengers in 2010

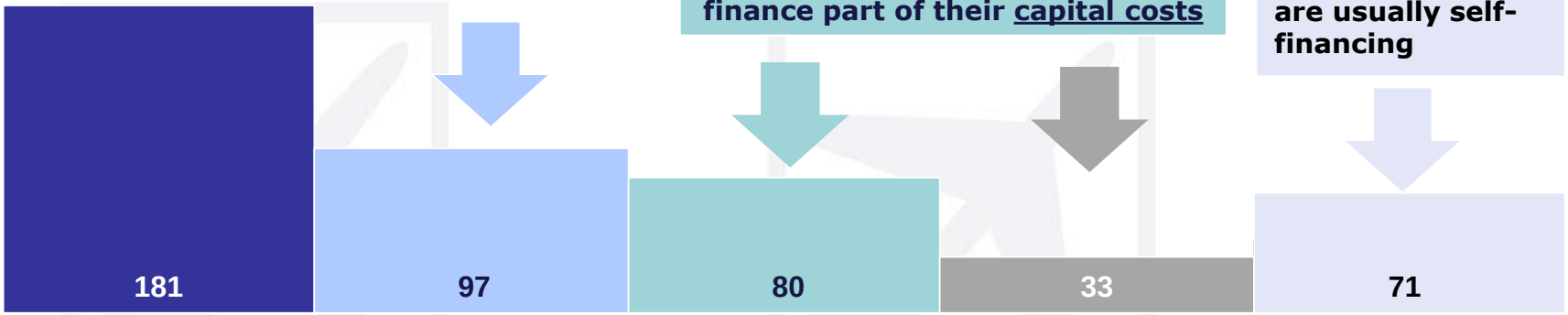
Financing of operation of these airports is covered by the 2012 SGEI Decision

~462 airports are used for commercial aviation

These airports usually cannot finance their operating costs from own revenue

These airports usually cannot finance part of their capital costs

These airports are usually self-financing



Small airports are not able to support all their costs

Source: ACI Europe, Data 2010.

Source: ACI, Year 2010.

Contact:

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  See also www.GAP-projekt.de