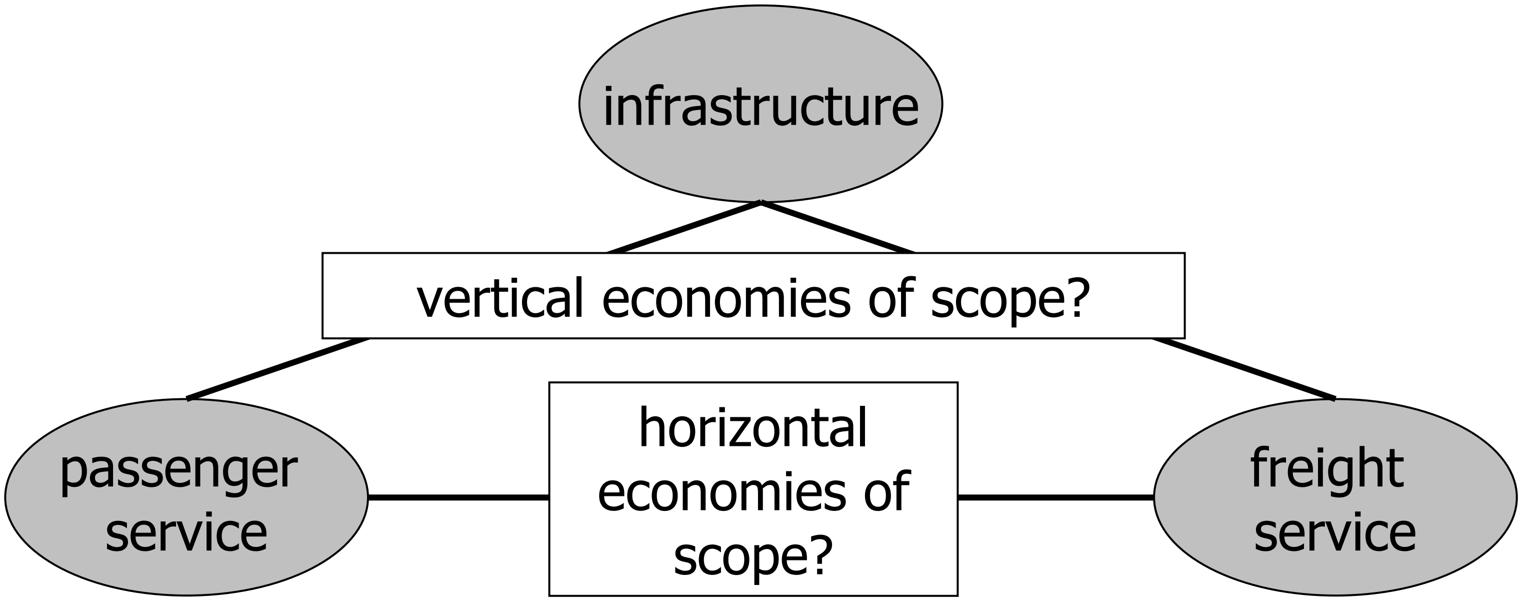
Economies of scope in European railways – an efficiency analysis

Christian Growitsch and Heike Wetzel

4th Conference on Applied Infrastructure Research
Berlin, 8 October 2005

1. introduction
2. theoretical background
3. data description
4. methodological approach
5. first stage results
6. second stage results

European regulation and sector structure



European regulation:

- accounting separation
- organizational separation
- (institutional separation)

Do economies of scope militate against separation?

economies of scope

cost information available:

- comparison of cost of joint production and separate production

$$C(\sum_{i=1}^{m} Y^i) < \sum_{i=1}^{m} C(Y^i)$$

no cost information:

- comparison of technical efficiency of joint production and separate production

efficiency of joint production	>	efficiency of separate production

data

- cross-country data: 23 European countries
- years of observation: 2000, 2001, 2002, 2003, 2004

company structure	number of firms	observations
integrated company (IC)	22	73
infrastructure manager (IM)	10	33 (23)
passenger operator (PO)	4 (15)	16 (28)
freight operator (FO)	8	14 (16)
passenger and freight operator (RU)	5	15
total	**49 (60)**	**151 (155)**

variables

first stage input–output variables:

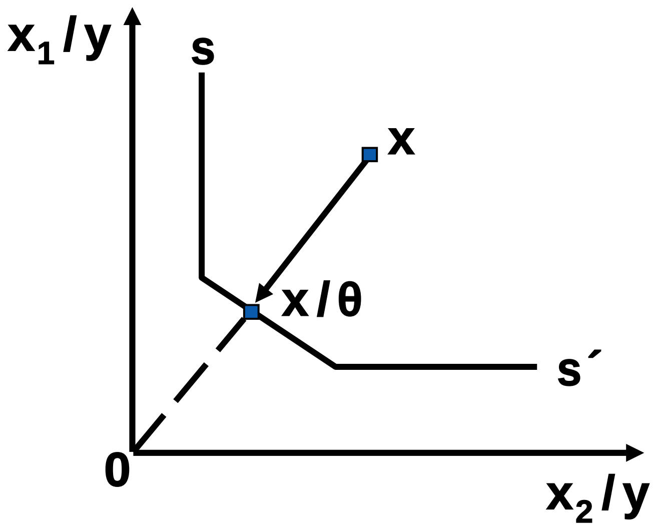
integrated company		infrastructure manager		transport operator (passenger / freight)	
inputs	outputs	inputs	outputs	inputs	outputs
employees	train-km	employees	train-km	employees	
rolling stock (opex)	pass.-km	(opex)		rolling stock (opex)	pass.-km
network length	freight ton-km	network length			freight ton-km

data envelopment analysis

production technology

- input distance function
- constant returns to scale

$D_I(x,y)=\max \{\theta:(x/\theta) \in L(y)\}$



technical efficiency:

$$[D_I(x,y)]^{-1} = \min \theta$$

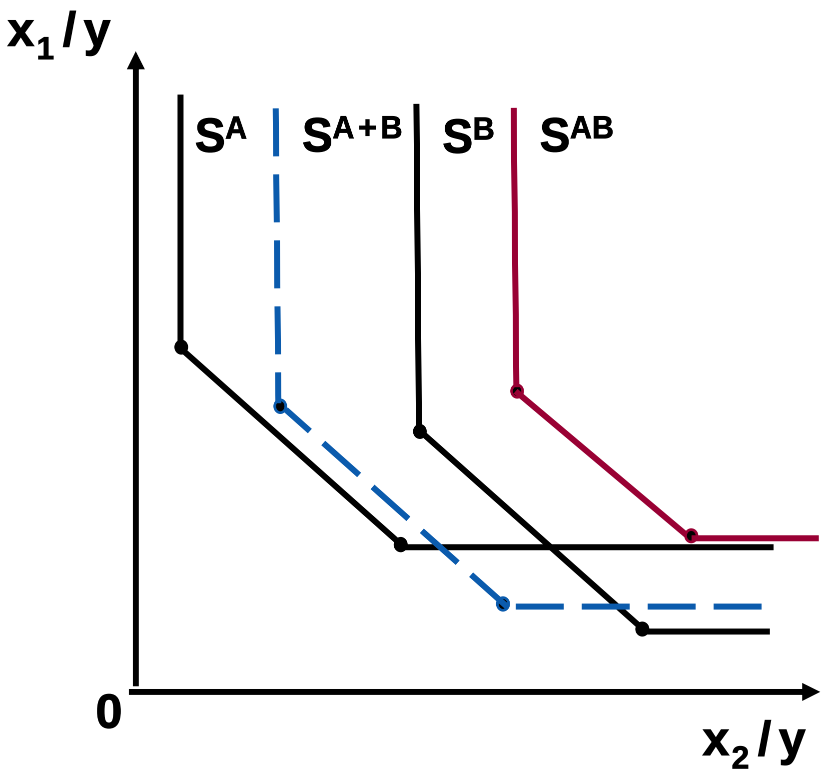
$$\text{s.t.} \quad -y_i + Y\lambda \geq 0$$

$$\theta x_i - X\lambda \geq 0$$

$$\lambda \geq 0$$

testing for economies of scope

comparision of efficiency between separate production (S^{A+B}) and joint production (S^{AB})



super efficiency scores:

$$\min \ \theta_j^*$$

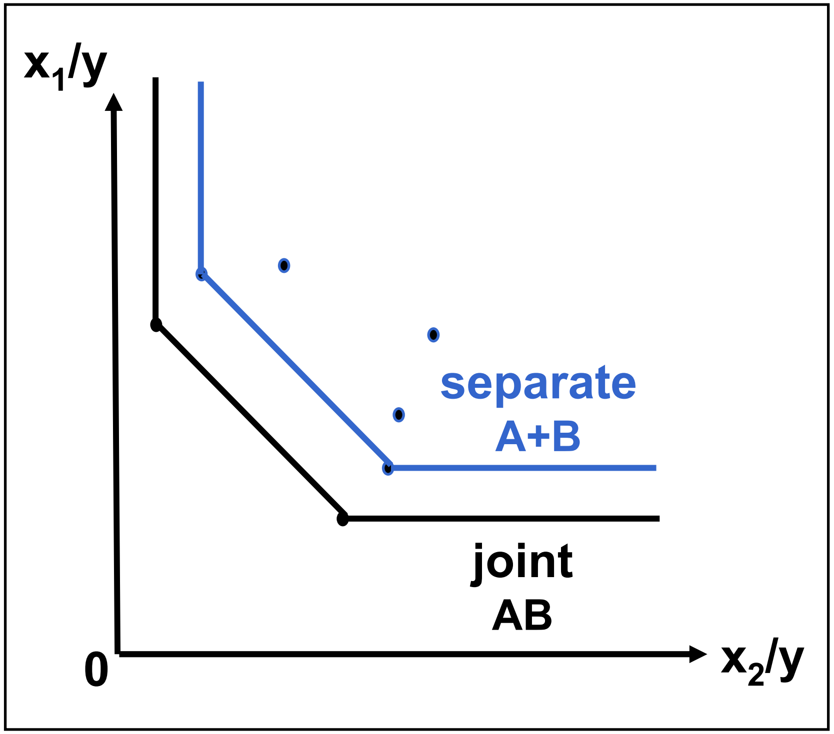
$$\text{s.t.} \quad -y_j + Y_s\lambda_s \geq 0, \ j \in E^{AB}$$

$$\theta_j^* x_j - X_s\lambda_s \geq 0, \ s \in E^{A+B}$$

$$\lambda_s \geq 0$$

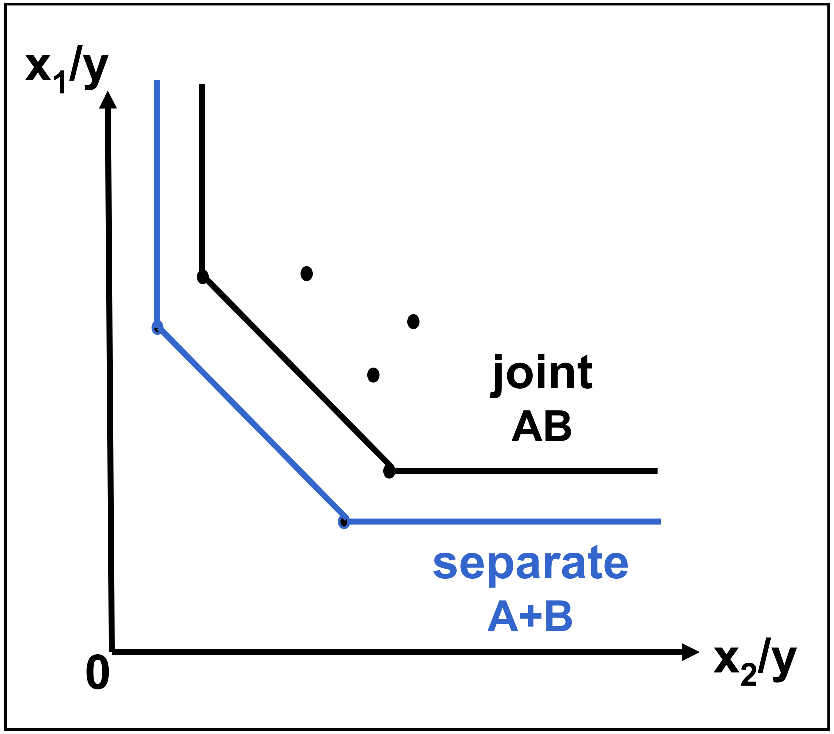
source: Morita 2002

testing for economies of scope



economies of scope

$\max\{\theta^*_{A+B}\} < 1$

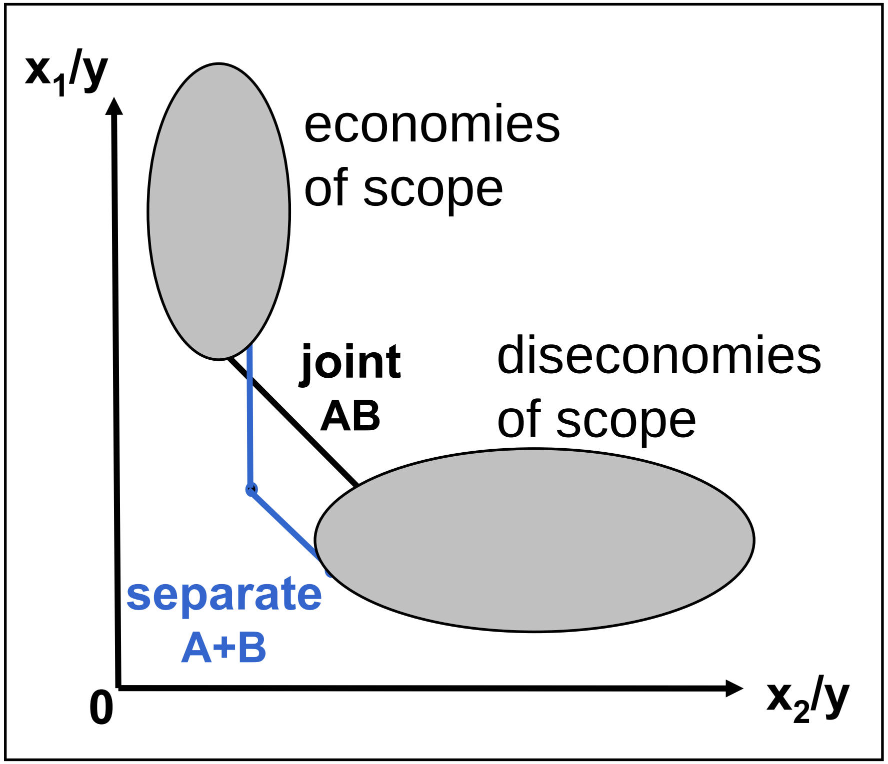


diseconomies of scope

$\max\{\theta^*_{AB}\} < 1$

testing for economies of scope

partial economies and diseconomies of scope:



$$\max\{\varphi_k^{AB}\} > 1, \max\{\varphi_k^{A+B}\} > 1$$

efficiency scores: model 1

efficiency scores	mean	minimum	maximum
integrated company (IC)	0,64	0,25	1,0 (11)
network manager (IM)	0,51	0,13	1,0 (3)
passenger operator (PO)	0,62	0,38	1,0 (2)
freight operator (FO)	0,42	0,06	1,0 (2)
passenger + freight operator (RU)	0,85	0,26	1,0 (3)
➔ 3 IM x 2 PO x 2 FO + 3 IM x 3 RU = 21			
virtually joint companies (VC)	0,96	0,93	1,0 (17)

super efficiency: model 1

joint production (efficient integrated companies):

mean	minimum	maximum
1,88	0,64	2,86

separate production (efficient virtually joint companies):

mean	minimum	maximum
13,99	1,57	27,35

➔ partial economies and diseconomies of scope

environmental influences

truncated regression:

$1/TE_{crs}$	Pure TE	OPEX TE
GDP per capita	-0.0005	-0.0000
Network density	-0.0801	-0.0047
Population density	-0.0919	-0.0033
dummy PO	10.8241	3.6435*
dummy FO	29.7052	0.0949
dummy IM	21.6824	1.6438
dummy RU	-48.6092	-0.9194
constant	-16.1622	-1.3599