

The effect of intermodal competition on the pricing behaviour of DB Fernverkehr AG

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Long-distance passengers transport: market, planning, innovation

Milano, 29.09.2017



Agenda

- **Introduction**
- **Hypotheses**
- **Data**
- **Method**
- **Results**
- **Conclusion**

Agenda

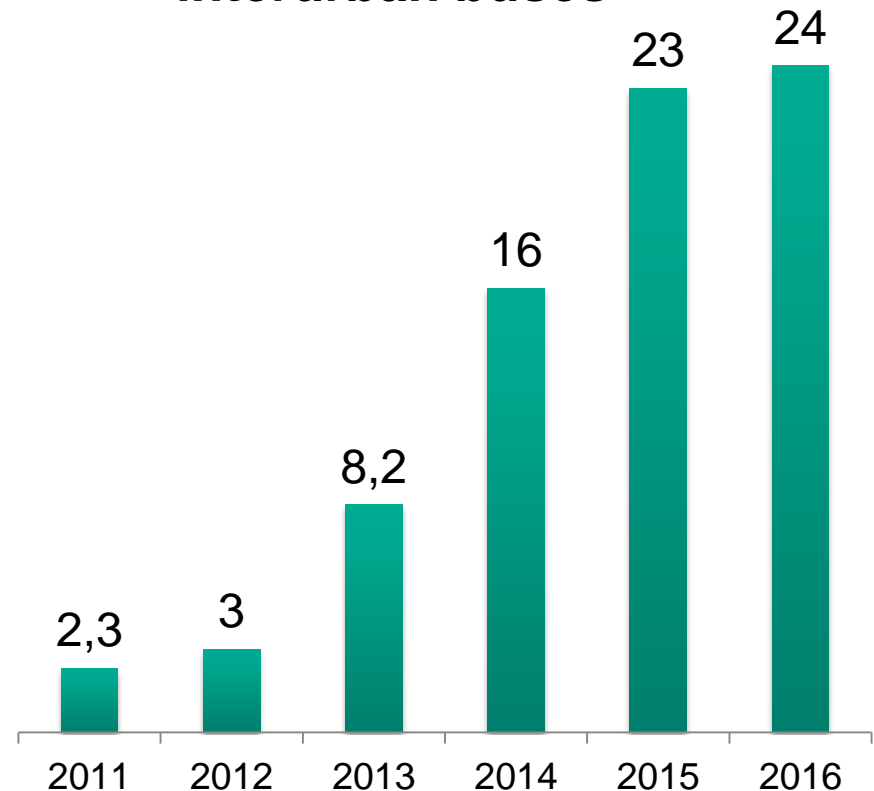
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New Passenger Transport Act § 42a since January 1st 2013

Intercity bus services are legal if:

- distance > 50 km
- travel time regional trains > 60 minutes
- No fare regulation

Million passengers of interurban buses



Sources: German Federal Statistical Office

Reaction of DB Fernverkehr AG

ICE Fahrkarte

Gültigkeit: ab 01.08.2017
GILT NUR FÜR EINGETRAGENE ZÜGE / TAGE / ZEITEN (ZUGBINDUNG); NV =
NAHVERKEHR SZÜGE VOR / NACH FERNVERKEHR SZÜGEN; GILT JE FAHRT
MAX. 1 TAG BIS FOLGETAG 10 UHR

Sparpreis (Einfache Fahrt)
Klasse 2
Erw. 1
Hinfahrt: Recklinghausen → Würzburg, mit ICE, (SPAR0029)
Über: NV Essen 18:41 ICE821
Umtausch/Erstattung kostenpflichtig bis 1 Tag vor 1. Geltungstag, danach
ausgeschlossen






Price reaction

- Budget tickets
- 19 Euro ticket campaigns
- No price increase for normal prices in 2015
- Reduction of booking deadlines

Investments reaction

- Investments of 12 billion Euro in new trains up to 2030
- Expansion of rail transport services
- WLAN in ICE trains

	Flexprice	Budget price	Special budget price
			
Availability	Bahn.de	Bahn.de	Bahn.de
Prices	x – 142 Euro	19-	19-
Specific train	No	Yes	Yes
Exchange	<ul style="list-style-type: none"> Up to the day before departure free, day of departure: €19 	<ul style="list-style-type: none"> Up to the day before departure: €19, day of departure: not possible 	<ul style="list-style-type: none"> Up to the day before departure: €19, day of departure: not possible

Are special budget prices of DB related to bus competition?

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Number of cheaper tickets (busliniensuche.de vs. bahn.de)

Number of cheaper €19 Euro tickets (busliniensuche.de vs. bahn.de)

Number of cheaper tickets depends on ...

H1: Market size	(+)
H2: Railway quality	(-)
H3: Intermodal competition	(+)

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Definition and Data

Definition: lines vs. routes

line	city	position
1	A	1
1	B	2
1	C	3

route	
start	destination
A	B
B	C
A	C

Data basis

- routes >70,000 inhabitants
- Distance >50 km
- Regional railway travel time >60 minutes
- 15.06-22.06.2015, 7 days before departure
- In total 13,473 routes
- Busliniensuche.de & Bahn.de
- Google.de/maps
- Federal Statistical Office
- Federal Ministry of Transport and digital Infrastructure

H1: Market size (+)	Log railway traffic volume in 2015	(+)
	Distance in kilometres	(-)
	Dummy 20,000 Students (1/0) in each city	(+)
H2: Railway quality (-)	Number of railway frequency per day	(-)
	Number of IC trains per day	(+)
	Dummy daily direct connections (1/0)	(-)
H3: Competition (+)	Dummy intermodal competition (1/0)	(+)

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**Two-step cluster
analysis**



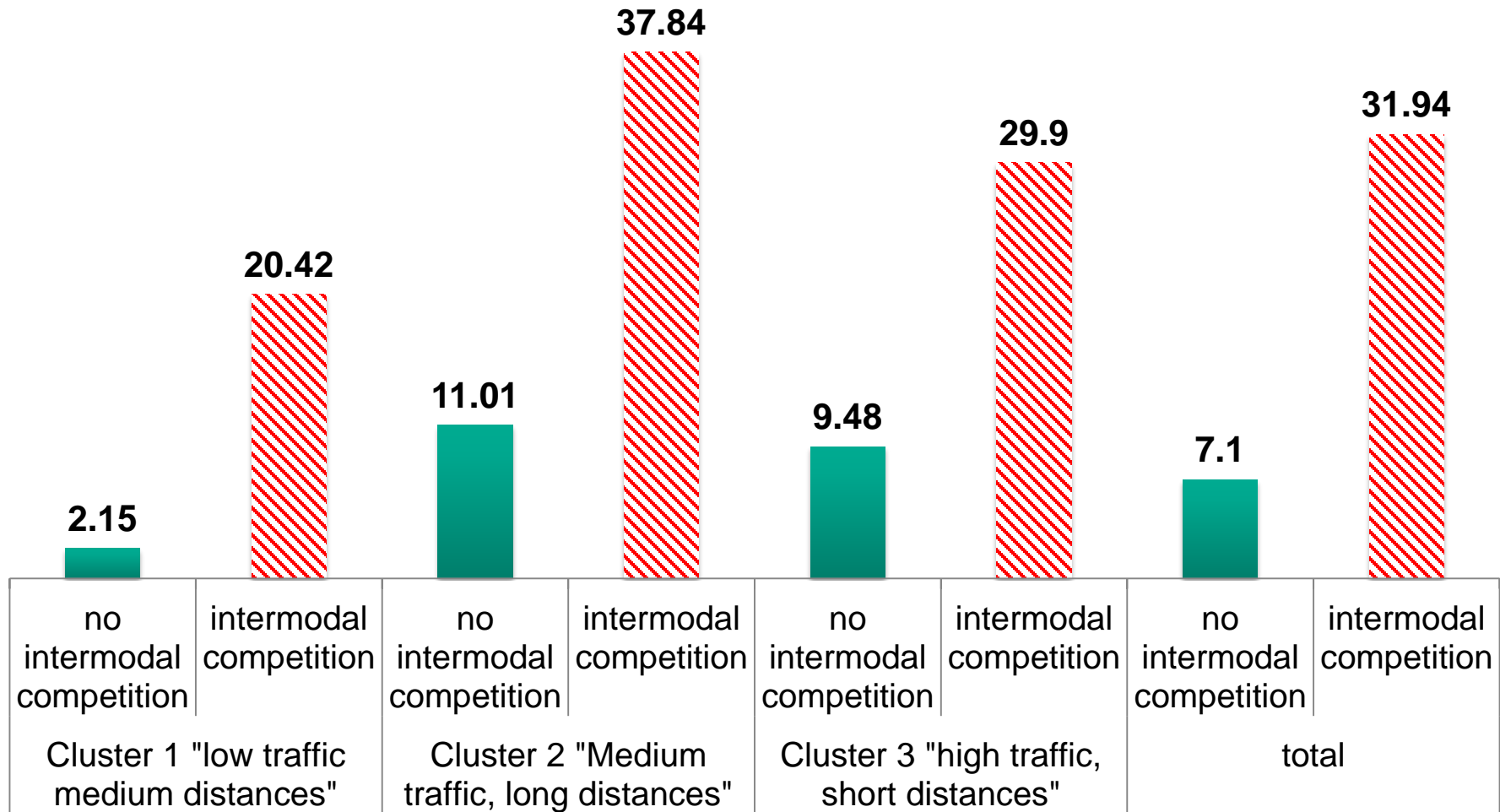
**Zero-inflated negative
binominal regression**

Two-step Cluster analysis

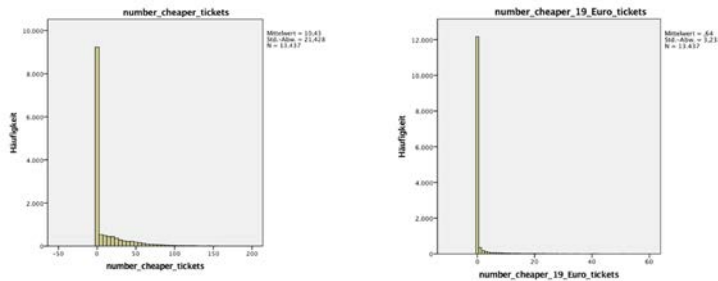
Cluster variables: $\ln(\text{railway traffic})$, kilometres

Cluster	Traffic	Distance	#	intermodal competition
Cluster 1	Low traffic	Medium distances	4,509	2%
Cluster 2	Medium traffic	Long distances	3,654	15%
Cluster 3	High traffic	Short distances	5,274	22%

Results cluster analysis – number of cheaper tickets



2. Step zero-inflated regression analysis



$$P(y_k) = \begin{cases} \pi_k + (1 - \pi_k) \left(\frac{v}{\mu + v} \right)^v, & y_k = 0 \\ (1 - \pi_k) \frac{\Gamma(v + y_k)}{\Gamma(v)\Gamma(y_k + 1)} \left(\frac{v}{\mu_k + v} \right)^v \left(\frac{\mu_k}{v + \mu_k} \right)^{y_k}, & y_k \geq 1 \end{cases}$$

Binary regression	Negative binominal regression
Dummy intermodal competition	In (railway traffic volume)
	Km
	Dummy _{students} 20.000
	railway frequency
	IC trips
	Dummy _{Direct}

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Number of cheaper tickets

		H	All routes	Cluster 1	Cluster2	Cluster 3
H1: Market size (+)	Transport volume	(+)	+***	+***	+***	+***
	Distance	(-)	+***	0***	0	+***
H2: Quality (-)	Dummy 20.000 Students (1/0)	(+)	+***	+***	+***	+***
	Railway frequency	(-)	+***	+***	+***	+***
	IC Trains	(+)	+***	+	+***	+***
	Dummy direct connections (1/0)	(-)	-***	+	-	-***
H3a: Competition (+)	Dummy intermodal competition (1/0)	(+)	+***	0	+***	+***

* p<0.1, ** p<0.05, *** p<0.01, green = in line with the hypothesis, red= not in line with the hypothesis

Number of cheaper €19 Euro tickets

		H	All routes	Cluster 1	Cluster 2	Cluster 3
H1: Market size (+)	Transport volume	(+)	+***	+***	+***	+***
	Distance	(-)	-***	-***	1	-***
	Dummy 20.000 Students (1/0)	(+)	+***	+	+	+***
H2: Quality (-)	Railway frequency	(-)	+**	+**	+	+***
	IC Trains	(+)	+***	+**	-***	+***
	Dummy direct connections (1/0)	(-)	+***	+***	-	+
H3a: Competition (+)	Dummy intermodal competition (1/0)	(+)	0	+	0	+***

* p<0.1, ** p<0.05, *** p<0.01, green = in line with the hypothesis, red= not in line with the hypothesis

Cheaper tickets	Cheaper €19 tickets
<ul style="list-style-type: none">• High traffic volume• long distances	<ul style="list-style-type: none">• High traffic volume• short distances
High railway frequency, high number of IC trips	
<ul style="list-style-type: none">• No direct connection	<ul style="list-style-type: none">• Direct connection
<ul style="list-style-type: none">• Intermodal competition has an positive effect in all clusters	<ul style="list-style-type: none">• Intermodal competition has an positive effect in Cluster 3

Agenda

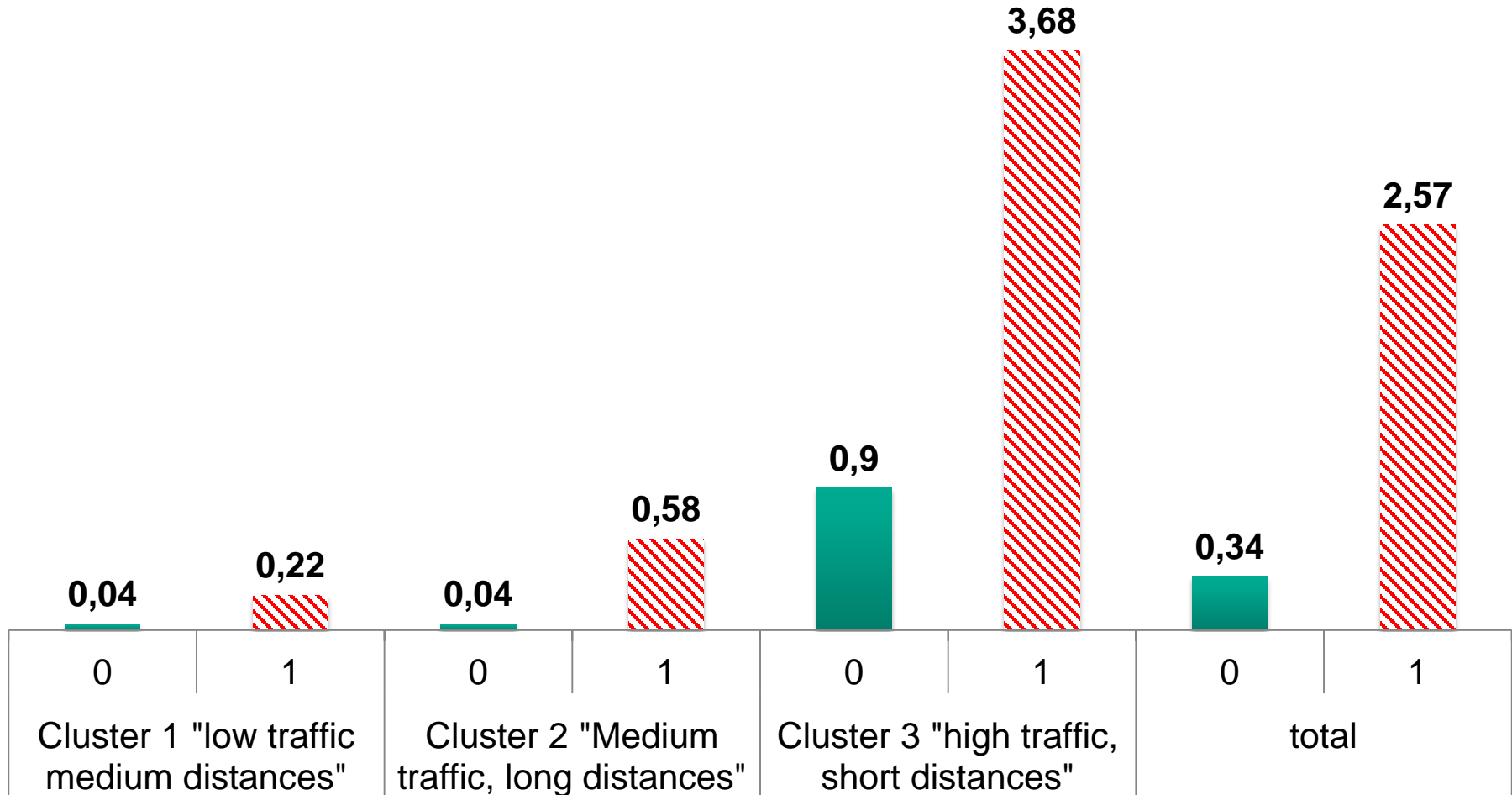
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- **Intermodal competition** leads to more special budget prices
- Different pricing behaviour depending on transport markets
- DB Fernverkehr is still a monopolist on 87% of the considered routes
- What happens after intercity bus consolidation?
- What happens if a toll for intercity buses will be introduced?

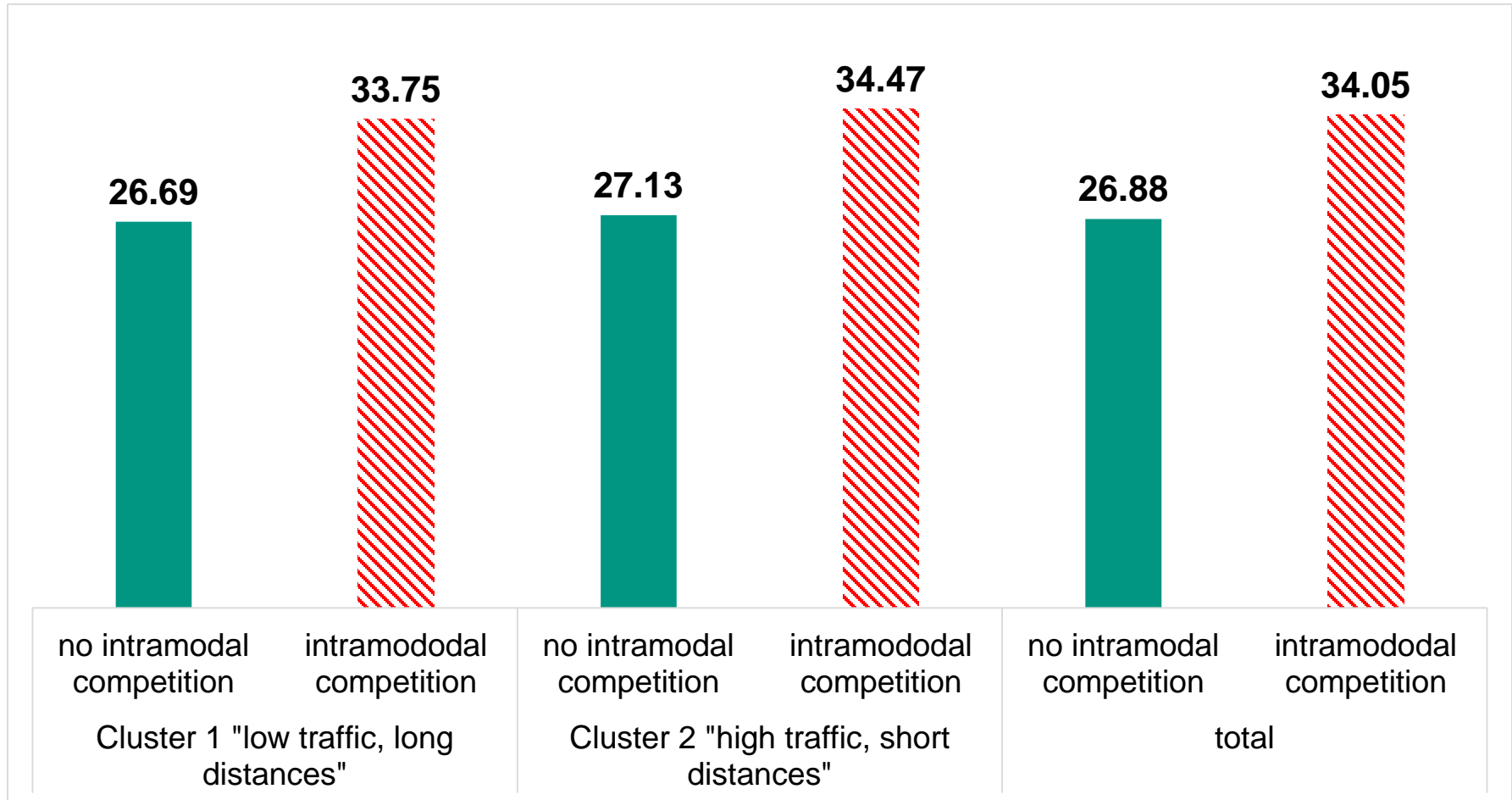
Thank you very much for your attention!

Backup

All railway routes – avg number of cheaper 19 Euro tickets



All competitive routes – avg number of cheaper tickets



Category	Variable	Description	Mean	Std. dev.	Min.	Max.
Market size	ln (railway traffic volume)	Logarithmized railway traffic volume on NUTS 3 level in 2015	5.38	2.43	-1.41	14.18
	km	Distance in km	364.42	169.26	50.20	1002.00
	Dummy _{Students 20,000}	=1 if both cities have more than 20,000 registered students	0.13	0.33	0.00	1.00
Quality of railway services	Railway frequency	Average railway frequency on all routes	30.74	14.15	1.00	96.86
	IC trips	Average number of trips with a maximum train type of IC	6.25	5.87	0.00	36.00
	Dummy _{Direct}	=1, if there is a direct railway connection	0.20	0.40	0.00	1.00
Competition	Dummy _{intermodal competition}	=1, if there is at least one intercity bus operator once per day	0.13	0.34	0.00	1.00

Category	Variable	Description	Mean	Std. dev.	Min.	Max.
Market size	In (railway traffic volume)	Logarithmized railway transport volume on NUTS 3 level in 2015	8.28	2.09	0.62	14.18
	km	Distance in km	362.79	171.89	50.30	950.00
	DummyStudents 20,000	=1 if both cities have more than 20,000 registered students	0.53	0.50	0.00	1.00
Quality of railway services	railway frequency	Average railway frequency on all routes	32.82	14.35	1.00	95.00
	IC trips	Average number of trips with a maximum train type of IC	6.21	5.80	0.00	32.00
	DummyDirect	=1, if there is a direct railway connection	0.58	0.49	0.00	1.00
Competition	Travel Time ratio bus - railway	Average travel time of intercity buses relative to the average railway travel time	1.44	0.42	0.39	3.73

Cheaper tickets

- Low transport volume
- long distances

Cheaper €19 tickets

- High transport volume
- short distances

High railway frequency, high number of IC trips

- intramodal competition has an positive effect
- especially in cluster 1

- intramodal competition has an positive effect
- especially in cluster 2

Number of cheaper railway tickets all railway routes

Variables	All railway routes	Cluster R1	Cluster R2	Cluster R3
ln(railway traffic volume)	1.255***	1.644***	1.235***	1.068***
	-0,01	0.045	0.016	0.014
km	1.002***	1.000***	1.000	1.004***
	0.000	0.001	0	0
Dummy Students 20,000	1.402***	3.330***	1.162***	1.332***
	0.037	0.213	0.056	0.044
Railway frequency	1.026***	1.018***	1.023***	1.031***
	0.001	0.004	0.002	0.002
IC trips	1.011***	1.016	1.013***	1.010***
	0.003	0.011	0.005	0.003
Dummy direct connection	0.800***	1.023	0.944	0.834***
	0.038	0.293	0.056	0.045
Constant	1.076	0.480**	2.901***	1.674***
	0.095	0.345	0.187	0.139

Coefficients of zero-inflated NB Regression

Constant	1.910***	2.630***	1.939***	2.280***
	0.023	0.082	0.044	0.041
Dummy intermodal competition	0.087***	0.000	0.093***	0.093***
	0.084	16.885	0.101	0.081

Number of cheaper €19.00 railway tickets all railway routes

Variables	All railway routes	Cluster R1	Cluster R2	Cluster R3
In(railway traffic volume)	1,594***	2,363***	1,774***	1,273***
	0,022	0,244	0,062	0,029
km	0,993***	0,970***	1	0,991***
	0	0,004	0,001	0,001
Dummy students 20,000	1,642***	2,208	1,336	1,284**
	0,099	0,698	0,204	0,099
Railway frequency	1,006**	1,037**	1,012	1,011***
	0,003	0,015	0,009	0,003
IC trips	1,047***	1,066**	0,903***	1,048***
	0,007	0,031	0,026	0,008
Dummy direct	1,332***	17,288***	3,010***	1,02
	0,099	0,83	0,199	0,104
Constant	0,121***	4,375	0,001***	1,374***
	0,205	1,407	0,76	0,29
<i>Coefficients of zero-inflated NB Regression</i>				
Constant	1,502***	10,206***	1,779*	3,248***
	0,095	0,878	0,348	0,146
Dummy intermodal competition	0	0,014	2,77	0,061***
	32,371	5,518	99,223	0,443

Number of cheaper tickets

		H	All routes	Cluster 1	Cluster2
H1: Market size (+)	Transport volume	(+)	-***	-	-***
	Distance	(-)	+***	1	+***
	Dummy 20.000 Students (1/0)	(+)	-	-	-
H2: Quality (-)	Railway frequency	(-)	+***	+***	+***
	IC Trains	(+)	+**	+***	+*
	Dummy direct connections (1/0)	(-)	-	-	-
	Travel time buses railway	(-)	+	+	-
	Price ratio railway buses	(+)	-	-	+
H3a: Competition (+)	Dummy intramodal competition (1/0)	(+)	+***	+***	+

* p<0.1, ** p<0.05, *** p<0.01, green = in line with the hypothesis, red= not in line with the hypothesis, black= not significant

Number of cheaper €19 Euro tickets

		H	All routes	Cluster 1	Cluster 2
H1: Market size (+)	Transport volume	(+)	+***	+***	-
	Distance	(-)	-***	-***	-*
	Dummy 20.000 Students (1/0)	(+)	+	+	-
H2: Quality (-)	Railway frequency	(-)	+*	+***	+***
	IC Trains	(+)	+***	-***	+***
	Dummy direct connections (1/0)	(-)	+	+**	+
	Travel time ratio buses railway	(-)	-	+	-
	Price ratio railway buses	(+)	+	+	-
H3a: Competition (+)	Dummy intramodal competition (1/0)	(+)	+***	0	+*

* p<0.1, ** p<0.05, *** p<0.01, green = in line with the hypothesis, red= not in line with the hypothesis

Number of cheaper railway tickets

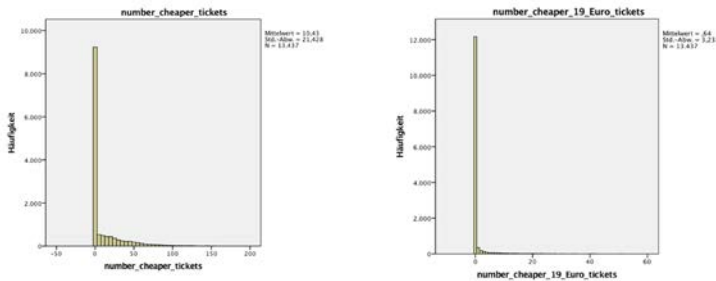
Variables	All intermodal competition routes	Cluster Z1	Cluster Z2
ln(railway traffic volume)	0.958***	0.988	0.894***
	0.012	0.014	0.026
km	1.001***	1	1.006***
	0	0	0.001
Dummy _{students 20,000}	0.963	0.951	0.943
	0.04	0.042	0.081
Railway frequency	1.030***	1.025***	1.035***
	0.002	0.002	0.003
IC trips	1.009**	1.011***	1.011*
	0.003	0.004	0.006
Dummy _{direct connection}	0.933	0.992	0.893
	0.045	0.048	0.092
Travel time _{buses railways}	1.031	1.004	0.938
	0.055	0.063	0.097
Price ratio _{railway buses}	0.985	0.99	0.101
	0.027	0.033	0.042
Constant	14.340***	19.846***	7.106***
	0.176	0.212	0.305
<i>Coefficients of zero-inflated NB regression</i>			
Constant	0.326***	0.300***	0.326***
	0.102	0.123	0.208
Dummy _{intramodal competition}	0.596***	0.418***	0.745
	0.128	0.174	0.234

Number of cheaper €19 Euro railway tickets

Variables	All intermodal competition routes	Cluster Z1	Cluster Z2
ln(railway traffic volume)	1.292*** 0.035	1.381*** 0.057	0.977 0.04
km	0.995*** 0	0.998*** 0.001	0.998* 0.001
Dummy _{students 20,000}	1.228 0.13	1.323 0.205	0.876 0.136
Railway frequency	1.010* 0.005	1.015*** 0.007	1.014*** 0.005
IC trips	1.048*** 0.01	0.909*** 0.024	1.052*** 0.01
Dummy _{direct}	1.183 0.145	1.639** 0.235	1.013 0.154
Travel time ratio _{buses railways}	0.783 0.156	1.156 0.306	0.884 0.16
Price ratio _{railway buses}	1.011 0.075	1.254 0.149	0.978 0.07
Constant	0.78 0.544	0.017*** 1.045	8.390*** 0.458
<i>Coefficients of zero-inflated NB regression</i>			
Constant	0.972 0.324	1.685*** 0.414	0.748 0.221
Dummy _{intramodal competition}	0.222*** 0.446	0.001 99.029	0.684* 0.23

H1: Market size (+)	Log railway transport volume in 2015	(+)
	Distance in kilometres	(-)
	Dummy 20,000 Students (1/0) in each city	(+)
H2: Railway quality (-)	Number of railway frequency per day	(-)
	Number of IC trains per day	(+)
	Dummy daily direct connections (1/0)	(-)
H3a: Competition (+)	Dummy intermodal competition (1/0)	(+)
H3b: Competition (+)	Dummy intramodal bus competition (1/0)	(+)

2. Step zero-inflated regression analysis



$$P(y_k) = \begin{cases} \pi_k + (1 - \pi_k) \left(\frac{v}{\mu + v}\right)^v, & y_k = 0 \\ (1 - \pi_k) \frac{\Gamma(v + y_k)}{\Gamma(v)\Gamma(y_k + 1)} \left(\frac{v}{\mu_k + v}\right)^v \left(\frac{\mu_k}{v + \mu_k}\right)^{y_k}, & y_k \geq 1 \end{cases}$$

All railway routes

Binary regression	Negative binominal regression
intermodal competition	x ln (railway traffic volume)
	km
	Dummy _{students 20.000}
	x ₄ railway frequency
	IC trips
	Dummy _{Direct}

All routes with intermodal competition

Binary regression	Negative binominal regression
intramodal competition	ln (railway traffic volume)
	x ₂ km
	Dummy _{students 20.000}
	railway frequency
	x ₅ IC trips
	Dummy _{Direct}
	Price ratio railway bus
	Travel time ratio bus railway