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Competition between Railway Operators and Low Cost Carriers in Long-Distance Passenger Transport

ESMT Competition Analysis

Hans W. Friederiszick

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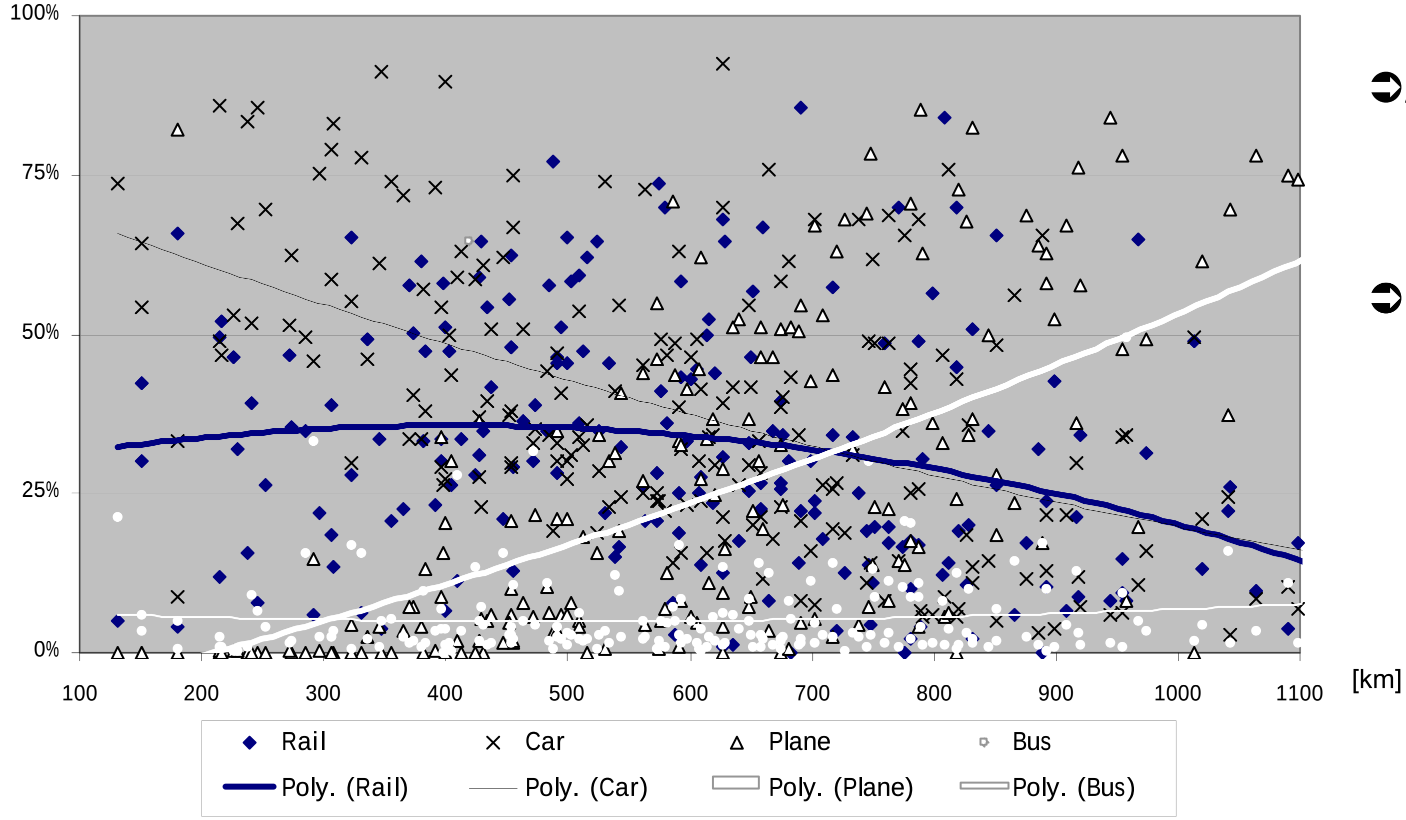
Editorial note:
ESMT Competition Analysis
has been renamed to
E.CA Economics

Background and Motivation

- The EU Commission's "Third Railways Package" foresees market opening of the European long-distance passenger rail sector after 2010
- European rail operators initiated or plan co-operations on long distance passenger transport
- There was concern that this co-operation would be anti-competitive
- DB argued that this concern was unfounded because inter-modal competition from low-cost airlines ("LCAs") servicing long-distance destinations provided sufficient competitive pressure

Background and Motivation

Intermodal split vs. distance



Source: Intraplan data; trend line ESMT CA; based on passenger figures; 2005 data

- Airlines appear to be effective for distances above 300-400 km
- Empirical assessment of the competitive pressure exerted by LCAs on railway operators

Main Findings

We find evidence of significant intermodal competition between low cost airlines (LCAs) and rail operators:

- Passengers
  - A rail operator loses at least 7% of its passengers and 8% of its passenger km due to entry by LCAs.
- Prices
  - Strategic entry is important
  - After accounting for strategic entry (endogeneity), LCA entry results in significantly lower prices.
  - Price effects vary between 16% and 27%
- Second/ first class
  - Affects both first and second class tariffs
  - Negative effects on passenger numbers are less pronounced for the first class

Overview

- Background and Motivation
- Related Literature
- Panel Data Analysis of Intermodal Competition in Long-Distance Rail Passenger Transport
- Policy Conclusions and Open Issues

Literature - Case Studies/ Simulations/ Scenario Analysis on Intermodal Competition

- Friebel and Niffka (2005) / Antes, Friebel, Niffka and Rompf (2004)
  - price rigidity of incumbent rail operator gives LCAs and incumbent airline strategic advantages
  - inter-modal price elasticities in the relevant literature might underestimate the actual degree of substitutability
- Ivaldi and Vibes (2005) – Cologne-Berlin
  - low cost train entry affects LCA more than rail incumbent
  - already a small number of competitors is sufficient to create strong competition on an intermodal level
- Lopez-Pita and Robuste-Anton (2003) – Madrid-Barcelona
  - high-speed trains likely to succeed planes as the dominant means of transportation on the route, with a market share increasing from currently 11% to 50-60%

This Page

- Examine effect of LCA entry and operation on DB
  - Prices
  - Passenger numbers

- Large, representative panel data set
  - With a rich set of controls

- Grapple with endogeneity
  - Standard panel data methods
  - IV methods accounting for the possibility that LCA entry is a strategic response to DB pricing

Data Set

- DB Data
  - Average first and second class ticket prices
  - Passenger numbers
  - For long-distance O&Ds wherein either the origin or destination (or both) lies within Germany

➲ 207 O&Ds observed over a period of 22 months from January 2006 to October 2007: 4554 O&D-month observations

- LCA competition: press releases and airline contacts
  - LCA entry and operation
  - LCA presence in 2006

- Control variables
  - Population & fuel cost data: Eurostat, Statistisches Bundesamt
  - Train type, railroad costs and track data: DB Trassenpreise; EICIS
  - Driving duration: Marco Polo Route planner 06/07
  - Number of airline seats and flights: Arbeitsgemeinschaft deutscher Verkehrsflughäfen (ADV)
  - Flight duration and delay: Association of European Airlines (AEA); ADV; Lufthansa

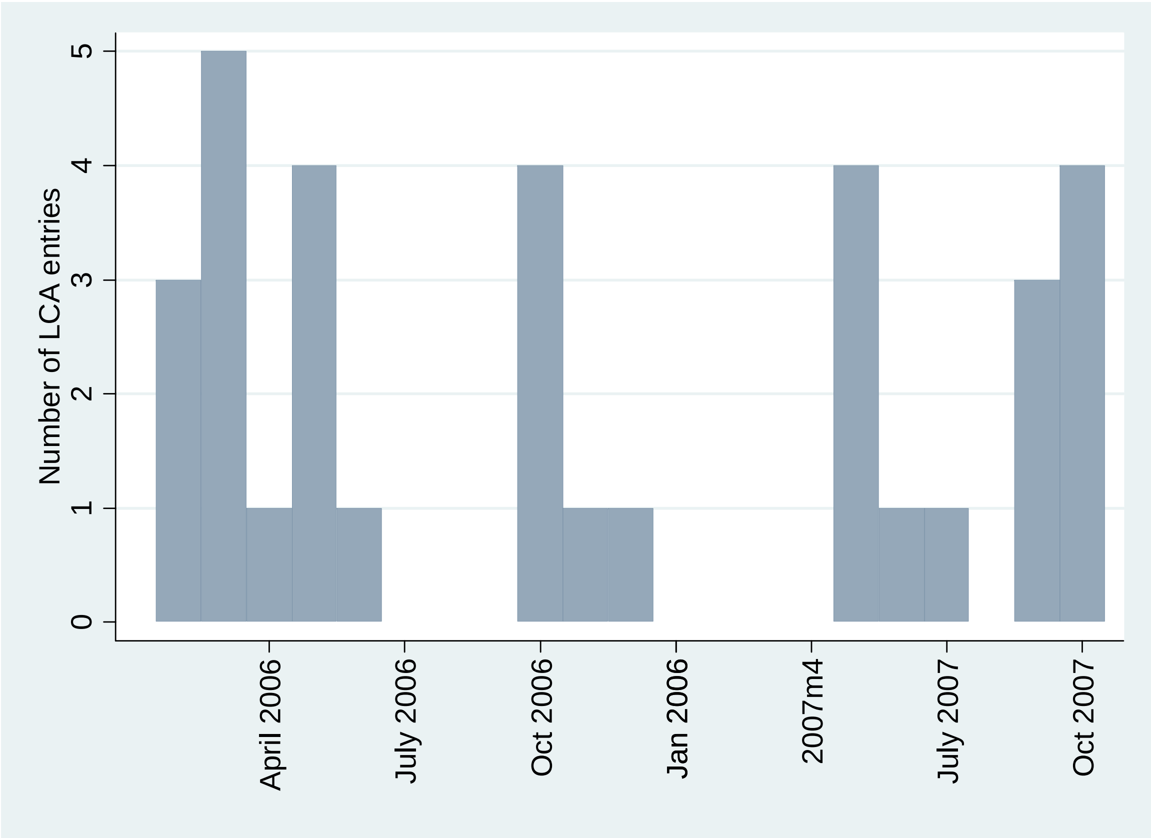
Descriptive Statistics – Cross Section

		Strong airline competition*	Weak arline competition
International route		I	II
	Number of observations	77	53
	Ratio Flight to Train (Simple average)	11,03	0,16
	Number of LCA entries	11	6
Domestic route		III	IV
	Number of observations	29	48
	Ratio Flight to Train (Simple average)	0,96	0,19
	Number of LCA entries	1	15

** Definition 'strong airline competition': ratio flight passengers to train passengers above 1*

- ➲130 international routes (63%)
- ➲Routes with and without pre-existing intermodal competition

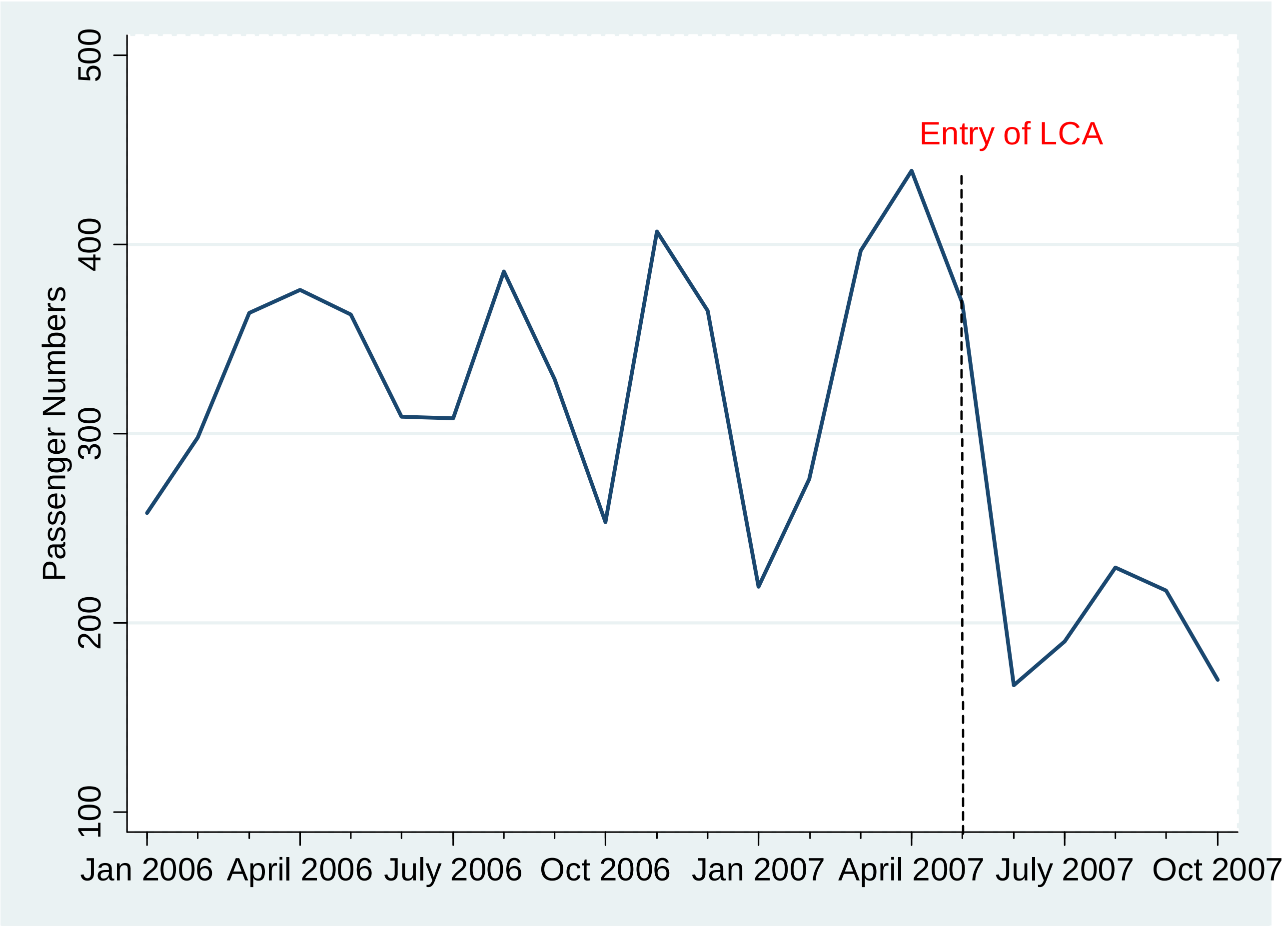
Descriptive Statistics – LCA Entry during Observation Period



➲16% of full sample (207 O&Ds) experienced LCA entries between January 2006 and October 2007

Example of LCA entry

Effect on passenger numbers (second class) due to LCA entry in May 2007



Panel Data Analysis – Model

Econometric model:

$$y_{it} = \delta LCA_{it} + \gamma \mathbf{z}_{it} + \lambda_t + \varepsilon_{it}$$

Where:

- *i* : a given O&D pair
- *t* : time
- y_{it} dependent variable, logarithm of
  - (i) passenger numbers (lpax), (ii) average ticket price (lavprice), (iii) revenue (lrev), (iv) passenger-kilometres (lpkm)
  - first class and second class
- LCA_{it} : dummy variable equal to 1 in the period of entry and subsequent operation for those routes which experienced LCA entry over our observation period
- δ : key indicator of the analysis: long-term percentage change of *y* because of LCA entry
- *z* : vector of control variables
- λ_t : control variable for seasonal effects
- ε_{it} : the error term

Panel Data Analysis – Endogeneity of Entry

- LCA entry is a strategic decision
  1. Entry → lower price (**negative** relation/correlation between entry and prices)
  2. High price → entry of LCA (**positive** relation/correlation between entry and prices)
- We are interested to identify effect 1

- In order to correctly support an antitrust analysis, the empirical methodology must account for this endogeneity and separate the effects!
  - ➲ We use instrumental variables (instruments are LCAs operating to another destination)

Panel Data Analysis – Endogeneity of Entry (continued)

- Need: an instrument which varies over O&Ds and over time
- Instrument:
  - Whether & to what extent the LCA operates into or out of the origin, to or from a city other than the destination
  - Whether & to what extent the LCA operates into or out of the destination, to or from a city other than the origin corresponding to O&D *i* at time *t*
- Rationale: LCAs have to operate on shoestring budgets. If they are already operating out of the O or D, this minimized their fixed costs of entry, therefore making entry more likely. At the same time, the presence of such networks is unlikely to be influenced by DB prices on the particular O&D in question.
- Data constraint: only have aggregate number of LCA operating on a given O&D
- Actual instrument:
  - Number of LCAs operating into or out of the origin, to or from a city other than the destination.
  - Number of LCAs operating into or out of the destination, to or from a city other than the origin corresponding to O&D *i* at time *t*.

Panel Data Analysis – Endogeneity of Entry (continued)

- We have a **binary endogenous regressor** (LCA_{it})

- 3 different estimation methods:

1. 2SLS:
   - ➲ consistent, but typically inefficient

2. Wooldridge-2SLS
   - Stage 0: probit with LCA_{it} as our dependent variable and all exogenous regressors (including our two instruments)
   - Predicted value from stage 0 regression used as sole regressor in first stage of standard 2SLS procedure

3. Maximum-Likelihood Approach
   - Considers LCA entry as endogenous treatment variable
   - Full information maximum likelihood

Results – Second Class log(Average Ticket Price)

Dep. Var.	lavprice2					LCA
	1	3	8	9	10	11
Expl. Var.	pooled OLS	RE	2SLS	W-2SLS	ML	
LCA	-0.00153	0.0241	-1.292***	-0.825***	-0.314**	
	(0.0237)	(0.0262)	(0.241)	(0.202)	(0.129)	
lairlines_orig						0.720***
						(0.0645)
lairlines_dest						0.128**
						(0.0497)
Constant	-0.350**	0.112	-1.057	-1.068*	-0.212	-2.594***
	(0.175)	(0.561)	(0.727)	(0.559)	(0.177)	(0.149)
Controls	YES	YES	YES	YES	YES	
Time dummies	YES	YES	YES	YES	YES	
No. Obs	4415	4415	4415	4415	4415	
No. O&Ds	207	207	207	207	207	
R-squared	0.451	0.45	-0.142	0.207		

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Results – First Class log(Average Ticket Price)

Dep. Var.	lavprice2					LCA
	1	3	8	9	10	11
Expl. Var.	Pooled OLS	RE	2SLS	W-2SLS	ML	
LCA	0.0337*	0.0245	-1.356***	-0.989***	-0.170***	
	(0.0189)	(0.0176)	(0.313)	(0.279)	(0.0511)	
lairlines_orig						0.674***
						(0.079)
lairlines_dest						0.140***
						(0.0433)
Constant	-0.905***	-1.226**	-0.0275	-0.224	-0.766***	-2.602***
	(0.173)	(0.522)	(0.882)	(0.741)	(0.174)	(0.14)
Controls	YES	YES	YES	YES	YES	
Time dummies	YES	YES	YES	YES	YES	
Fuel costs	YES	YES	YES	YES	YES	
No.Obs	3886	3886	3886	3886	3886	
No. O&Ds	201	201	201	201	201	
R-squared	0.59	0.588	-0.0428	0.248		

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Note: Full sample. controls include presence06, domestic, lorig_pop, ldest_pop, lauto_km, ICE

Panel Data Analysis – Overview Results

	Complete sample					Additional controls				
	Random effects				IV (ML)	Random effects				IV (ML)
Column number	1	2	3	4	5	6	7	8	9	10
Depend. variable	**Passengers**	**Avg. Price**	**Revenues**	**Pkm**	**Avg. Price**	**Passengers**	**Avg. Price**	**Revenues**	**Pkm**	**Avg. Price**
Second class										
Effect of LCC entry (□)	**- 6.8%****	**2.40%**	**-4.50%**	**- 8.9%****	**-27.0%*****	**-17.0%*****	**0.00%**	**-16.7%*****	**-16.4%*****	**-17.6%*****
No. obs	4421	4415	4415	3527	4415	1652	1652	1652	1652	1652
No. O&Ds	207	207	207	168	207	84	84	84	84	84
R-squared	0.394	0.45	0.43	0.279		0.684	0.767	0.641	0.578	
First class										
Effect of LCC entry (□)	**0.003%**	**2.50%**	**3.80%**	**1.00%**	**-15.6%*****	**-18%*****	**3.6%****	**-15.7%*****	**-23.1%*****	**-19.7%*****
No. obs	3916	3886	3886	3325	3886	1634	1631	1631	1634	1631
No. O&Ds	201	201	201	168	201	84	84	84	84	84
R-squared	0.498	0.588	0.439	0.238		0.758	0.757	0.744	0.715	

*p<.10, **p<.05, ***p<.01; “Complete sample” controls for LCA presence, domestic route, prices of coal, kerosene & oil, distance, orig & dest popn., and ICE ; “Additional controls” also controls for number of seats, flights, flight delay, driving duration, train duration, air duration, railpath prices.

Effect of LCA Entry – Summary of Results

- Passengers - second class
  - Statistically and economically significant negative effect on passenger numbers
  - 7%-17% decrease of passenger numbers, depending on dataset
- Passengers - first class
  - Negative effect on passenger numbers less pronounced
  - Up to 18%, depending on dataset
- Prices
  - Strategic entry is important
  - After accounting for strategic entry (endogeneity), LCA entry results in significantly lower prices in both the first and second class. Price effects vary between 16% and 27%

Policy Conclusions and Open Issues

Policy conclusion

- LCAs induce substantial competitive pressure
- Competitive pressure can be observed in first and second class and has an effect on both passenger numbers and prices
- Intermodal competition has to be part of a competitive assessment of future rail alliances

Open Issues

- Time varying effects of entry
- Appropriateness of instrument

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Railway Alliances in EC Long-Distance Passenger Transport: A Competitive Assessment Post-Liberalization 2010

ESMT White Paper series

http://www.esmt.org/eng/faculty-research/white-papers/

Data: Descriptive Statistics

Variable	Variable Description	Obs	Mean	Std. Dev.
DEPENDENT VARIABLES				
lavprice2	(Log) average second class ticket price	4415	4.03	.45
lpax2	(Log) number of second class train passengers	4421	5.79	2.48
lrev2	(Log) second class revenue	4415	9.77	2.29
lpkm2	(Log) second class passenger – kms of train traffic	3527	12.64	2.11
lavprice1	(Log) average first class ticket price	3886	4.52	.47
lpax1	(Log) number of first class train passengers	3916	4.24	2.38
lrev1	(Log) first class revenue	3886	8.67	2.18
lpkm1	(Log) first class passenger – kms of train traffic	3325	10.76	2.31

Data: Descriptive Statistics (cont'd.)

Variable	Variable Description	Obs	Mean	Std. Dev.
LCA COMPETITION				
LCA	LCA=1 if LCA entered and operated during sample period, else LCA=0	4554	.09	.28
presence06	presence06=1 if LCA was in operation before and during sample period, else presence06=0	4554	.12	.33
domestic	domestic=1 if both origin and destination located within Germany, else domestic=0	4554	.63	.48

Data: Descriptive Statistics (cont'd.)

Variable	Variable Description	Obs	Mean	Std. Dev.
RAIL DEMAND SHIFTERS				
lorig_pop	(Log) population in the origin catchment's area	4554	8.21	.80
ldest_pop	(Log) population in the destination catchment's area	4554	8.18	.71
ldistance	(Log) road distance	4554	6.27	.44

Data: Descriptive Statistics (cont'd.)

Variable	Variable Description	Obs	Mean	Std. Dev.
AIRLINE SUPPLY & QUALITY				
lseats	(Log) number of seat, e.g. capacity	3328	4.24	1.55
lflights	(Log) number of flights	3328	.81	.51
lagldelay	(Log) lagged flight delay on route	3192	3.39	.16
lair_dur	(Log) flight duration (min)	3066	4.78	.59

Data: Descriptive Statistics (cont'd.)

Variable	Variable Description	Obs	Mean	Std. Dev.
AUTOMOBILE QUALITY				
lauto_dur	(Log) duration by auto (min)	4554	5.71	.50
RAILWAY COSTS AND QUALITY				
ltrain_dur	(Log) duration by train (min)	4510	5.80	.45
lrailfast_price	(Log) cost for the fastest train path (€)	3534	1.30	.48
lraillow_price	(Log) lowest cost of train path (€)	3534	1.08	.30
lcoal	(Log) price for plant coal	4554	.06	.00
ICE	ICE=1 for ICE train type, else ICE=0	4554	.50	.50

Maximum Likelihoodfunction

Estimate the following model using ML (where x_{it} contains excluded instruments and you have the standard observation rule):

$$y_{it} = \delta LCA_{it} + \gamma \mathbf{z}_{it} + \lambda_t + \varepsilon_{it}$$

$$LCA_{it} = \phi x_{it} + \lambda_t + v_{it}$$

ε_{it} and v_{it} assumed to be are bivariate normal with a mean zero and covariance matrix:

$$\begin{bmatrix} \sigma & \rho \\ \rho & 1 \end{bmatrix}$$

➲ More efficient and also consistent (provided the model is correctly specified)