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MODELLING COMPETITION BETWEEN AIR AND RAIL TRANSPORT. THE CASE OF THE ROME-MILAN CORRIDOR

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1. Introduction

Motivations

- Great attention of the European Commission at the Ro-Mi corridor (COST318, Steer, Davies Gleave, 2006);
- Intensive Italian Antitrust Authority activities;
- Existing studies based on qualitative analysis, not updated or carried out by a not specified methodology;
- Features and recent market developments of both Italian air and rail transport markets.

2. Research questions

to develop models to test the travel preferences and competition in the Ro-Mi corridor

to simulate operators' reactions to potential policy changes.

1. Which **attributes** are important for the Ro-Mi passengers' choice?
2. Which are the **own and cross-point elasticities**?
4. Which are the **market shares in the Ro-Mi corridor**?
5. Which are the Ro-Mi passengers' reactions to hypothetical **policy changes**?

3. Literature analysis

Research aspects reviewed:

- Type of data collected
- Geographical area of study
- Modes covered
- Attributes covered
- Place and method of interview administration
- Number of interviews administered
- Econometric model used

4. Methodology

- **Stated** and **Revealed Preference** data
- **Combining** Stated and Revealed Preference data sources
- The theory of **discrete choice models** (McFadden, 1978-1984; Train, 1986-2000; Ben-Akiva, Bierlaire, 1999; Hensher, Rose, Greene, 2005).
- The theory of the **experimental design** (Bliemer, Rose, 2009-2010-2011; Scarpa, Rose, 2008; Hess, Rose, 2012; Bliemer, Rose, Hess, 2008).

5. The Rome-Milan case study

- **Description of the study area**
- **Data collection and sampling**
- **Descriptive results**
- **Econometric results**
  - Own and cross-point elasticity measures,
  - Logit models (joint SP-RP models to determine market shares),

Description of the study area

- Long distance corridor: 500 km,
- 5 airports,
- 3 airlines,
- 2 HSR operators.

Data collection and sampling

The experimental design strategy:

Waves of the design	Type of design	N. interviews	Nobs.	%
Wave 1 – Pilot test	**Fracional Factorial Design**	6	40	1%
Wave 2nd	**Efficient Design**	102	510	7%
Wave 3th	**Efficient Design**	1.278	6.390	92%
Total:		*1.386*	*6.940*	*100%*

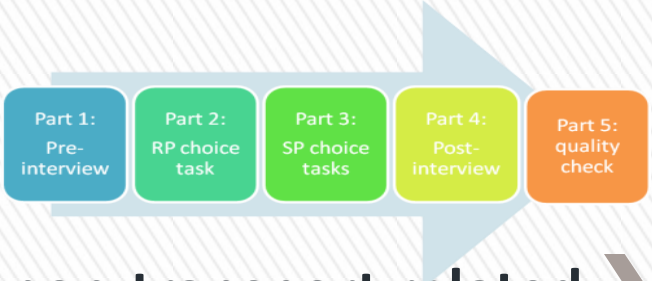
The choice set definition:

Mix of techniques (literature review & *ad hoc* survey).

The management of the data collection:

11 interviewers (graduate candidate).

The RP and SP questionnaire:



1.386 total interviews collected also in non-transport related places

Data collection and sampling

The choice set elements:

Alternatives: # 4 (HSR1, HSR2, FSC, LCC)

Attributes:

- Total travel time
- Total travel cost
- Flexibility (booking)
- Delay
- On-board services

We realized an *ad hoc* survey, 420 interviews

Attributes-levels:

- Total travel time : minutes – 5 levels
- Total travel cost: € – 5 levels
- Flexibility (booking)
- Delay: minutes – 3 levels
- On-board services: qualitative attribute – 3 levels:

FLEXIBILITY:

✓Level_1_HSR: not ticket change,
✓Level_2_HSR: ticket change until the departure,
✓Level_3_HSR: ticket change until 1 hour after the departure.

✓Level_1_AIR: not ticket change,
✓Level_2_AIR: ticket change until 2 days before with a supplement (60€),
✓Level_3_AIR: ticket change until 2 days before the departure without a supplement.

ON-BOARD SERVICES:

✓Level_1_HSR: mobile phone,
✓Level_2_HSR: internet,
✓Level_3_HSR: mobile phone+internet.

Selected descriptive results

- Profile of a "*Ro-Mi traveler*":
  - Male, 38 years old, University education, staff employed, income € 1.500 - € 2.500, use occasionally HSR and air transport, travelled by FSC, for a *business* purpose.

Travel purpose	Transport mode used in last Ro-Mi travel			
Purpose:	HSR	FSC	LCC	Total:
Tourism	21%	10%	28%	18%
Business	42%	72%	43%	54%
Study	6%	4%	6%	6%
Visiting friends, relatives, parents	27%	13%	21%	21%
Other	3%	1%	2%	2%
Total:	100%	100%	100%	100%

Levels of income	Transport mode used in the last Ro-Mi travel			
	HSR	FSC	LCC	Total:
< 500€	17%	4%	28%	14%
501€ - 1.500€	32%	23%	35%	29%
1.501€ - 2.500€	24%	31%	19%	26%
2.501€ - 3.500€	13%	22%	9%	16%
3.501€ - 4.500€	9%	11%	3%	9%
> 4.500€	5%	10%	6%	7%
Total:	100%	101%	100%	100%

Own and cross-point elasticity measures

Using the *probability weighted sample enumeration* technique (Hensher, Rose, 2000)

Direct and cross point elasticity for **TT COST** - overall			
MNL		ML	
TTC on HSR1:	value	TTC on HSR1:	value
HSR 1	-0,8086*	HSR 1	-1,3060*
HSR 2	0,2732	HSR 2	0,3886
FSC	0,261	FSC	0,3314
LCC	0,2948	LCC	0,3824
TTC on HSR2:	value	TTC on HSR2:	value
HSR 1	0,2807	HSR 1	0,407
HSR 2	-0,6206*	HSR 2	-1,2401*
FSC	0,2497	FSC	0,3174
LCC	0,2529	LCC	0,3841
TTC on FSC:	value	TTC on FSC:	value
HSR 1	0,3307	HSR 1	0,3403
HSR 2	0,311	HSR 2	0,3265
FSC	-1,2813*	FSC	-1,9866*
LCC	0,3299	LCC	0,3328
TTC on LCC:	value	TTC on LCC:	value
HSR 1	0,2879	HSR 1	0,4795
HSR 2	0,2839	HSR 2	0,4721
FSC	0,3154	FSC	0,4463
LCC	-0,8978*	LCC	-1,3744*

Direct and cross point elasticity for **TT TIME** - overall			
MNL		ML	
TTC on HSR1:	value	TTC on HSR1:	value
HSR 1	-1,8078*	HSR 1	-2,7858*
HSR 2	0,6213	HSR 2	0,8385
FSC	0,6445	FSC	0,8955
LCC	0,5967	LCC	0,8661
TTC on HSR2:	value	TTC on HSR2:	value
HSR 1	0,6855	HSR 1	1,0717
HSR 2	-1,5012*	HSR 2	-2,4934*
FSC	0,5932	FSC	1,0303
LCC	0,6139	LCC	1,0959
TTC on FSC:	value	TTC on FSC:	value
HSR 1	0,432	HSR 1	0,5141
HSR 2	0,3471	HSR 2	0,5025
FSC	-1,6002*	FSC	-2,8075*
LCC	0,4421	LCC	0,5714
TTC on LCC:	value	TTC on LCC:	value
HSR 1	0,5359	HSR 1	0,9261
HSR 2	0,456	HSR 2	0,8768
FSC	0,5263	FSC	0,9753
LCC	-1,5342*	LCC	-2,4171*

Own and cross-point elasticity measures

Total travel time: segmenting by type of pax

Direct and cross point elasticity for **TT TIME - business**				Direct and cross point elasticity for **TT TIME - non-business**			
MNL		ML		MNL		ML	
TTC on HSR1:	value	TTC on HSR1:	value	TTC on HSR1:	value	TTC on HSR1:	value
HSR 1	-2,927*	HSR 1	-4,396*	HSR 1	-1,170*	HSR 1	-1,651*
HSR 2	0,8055	HSR 2	1,0329	HSR 2	0,4733	HSR 2	0,6485
FSC	0,7536	FSC	1,0262	FSC	0,5684	FSC	0,7053
LCC	0,7438	LCC	1,0759	LCC	0,4794	LCC	0,6742
TTC on HSR2:	value	TTC on HSR2:	value	TTC on HSR2:	value	TTC on HSR2:	value
HSR 1	0,8996	HSR 1	1,2274	HSR 1	0,5188	HSR 1	0,7798
HSR 2	-2,633*	HSR 2	-4,154*	HSR 2	-0,938*	HSR 2	1,488*
FSC	0,7809	FSC	1,2377	FSC	0,4438	FSC	0,7436
LCC	0,7652	LCC	1,3051	LCC	0,471	LCC	0,7907
TTC on FSC:	value	TTC on FSC:	value	TTC on FSC:	value	TTC on FSC:	value
HSR 1	0,934	HSR 1	1,3281	HSR 1	0,223	HSR 1	0,2903
HSR 2	0,8779	HSR 2	1,3154	HSR 2	0,1498	HSR 2	0,2857
FSC	-2,213*	FSC	-3,748*	FSC	-1,214*	FSC	-1,790*
LCC	0,9719	LCC	1,492	LCC	0,2119	LCC	0,3193
TTC on LCC:		TTC on LCC:	value	TTC on LCC:	value	TTC on LCC:	value
HSR 1	0,8738	HSR 1	1,193	HSR 1	0,3453	HSR 1	0,4815
HSR 2	0,7441	HSR 2	1,1228	HSR 2	0,2917	HSR 2	0,4619
FSC	0,8344	FSC	1,311	FSC	0,3395	FSC	0,1883
LCC	-1,534*	LCC	-3,998*	LCC	-1,089*	LCC	-1,619*

Own and cross-point elasticity measures

Total travel cost: segmenting by type of pax

Direct and cross point elasticity for **TT COST - business**				Direct and cross point elasticity for **TT COST - non-business**			
MNL		ML		MNL		ML	
TTC on HSR1:	value	TTC on HSR1:	value	TTC on HSR1:	value	TTC on HSR1:	value
HSR 1	-0,555*	HSR 1	-0,940*	HSR 1	-0,965*	HSR 1	-1,432*
HSR 2	0,1553	HSR 2	0,2876	HSR 2	0,3847	HSR 2	0,4664
FSC	0,1314	FSC	0,2287	FSC	0,412	FSC	0,4061
LCC	0,1523	LCC	0,2776	LCC	0,4387	LCC	0,4676
TTC on HSR2:	value	TTC on HSR2:	value	TTC on HSR2:	value	TTC on HSR2:	value
HSR 1	0,1488	HSR 1	0,2659	HSR 1	0,3934	HSR 1	0,497
HSR 2	-0,425*	HSR 2	-0,937*	HSR 2	-0,758*	HSR 2	1,3628*
FSC	0,1295	FSC	0,2183	FSC	0,3794	FSC	0,3826
LCC	0,1174	LCC	0,2527	LCC	0,3947	LCC	0,4726
TTC on FSC:	value	TTC on FSC:	value	TTC on FSC:	value	TTC on FSC:	value
HSR 1	0,3145	HSR 1	0,4948	HSR 1	0,2849	HSR 1	0,32
HSR 2	0,3272	HSR 2	0,4961	HSR 2	0,2388	HSR 2	0,3046
FSC	-0,739*	FSC	-1,3152*	FSC	-1,703*	FSC	-2,197*
LCC	0,2919	LCC	0,4897	LCC	0,2853	LCC	0,3122
TTC on LCC:	value	TTC on LCC:	value	TTC on LCC:	value	TTC on LCC:	value
HSR 1	0,1967	HSR 1	0,3435	HSR 1	0,329	HSR 1	0,3899
HSR 2	0,1974	HSR 2	0,3502	HSR 2	0,3203	HSR 2	0,376
FSC	0,2098	FSC	0,3386	FSC	0,3724	FSC	0,3426
LCC	-0,569*	LCC	-1,007*	LCC	-1,130*	LCC	-1,689*

SP data

RP data

Econometric model' results

Attributes	Coeff.
Random parameters in utility functions	
COST	-0.03697***
TIME	-0.02599***
Nonrandom parameters in utility functions	
DELAY	-0.011177***
FLEX	-0.00028
SERVICE_SP	-0.03987***
ASC_FSC	0.38087***
ASC_LCC	-0.40786***
Heterogeneity in mean, Parameter:Variable	
COST:INCOME	0.00499***
COST:GENDER	-0.00065
COST: INSTRUCTION	-0.00030
COST: PURPOSE_BUSINESS	0.01124***
TIME:INCOME	-0.00101**
TIME:GENDER	0.00416***
TIME: INSTRUCTION	0.00535***
TIME: PURPOSE_BUSINESS	-0.01170***
Distns. of RPs. Std.Devs or limits of triangular	
TsCOST	0.03697***
TsTIME	0.02599***
Log likelihood function:	-7816.800
AIC:	15659.6
R2-adj.:	.42972
Nobs.:	7.650

Joint SP+RP ML model with socio-economic and behavioral data:

The average sensitivity of the **total travel cost** depends on respondents' income and travel purpose.

- In particular, respondents with a high income level or who travel for a business purpose are less sensitive to travel cost.

Moreover, the **total travel time** attribute is also affected by gender, income, level of instruction of respondents, and travel purpose.

- In particular, respondents with a high income level or who travel for a business purpose are more sensitive to travel time.

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

The estimated Ro-Mi market shares

Table 60 – Base case scenario (joint SP-RP ML model)

Parameters	Trenitalia	NTV	Alitalia-Cai	Ryanair
				
Total travel time	3 h 40'	4 h 5'	3 h 10'	5 h
Time travel cost	80€	104€	150€	89€
Delay	4'	4'	10'	7'
Market share:	**45%**	**20%**	**25%**	**9%**

Source: own elaboration

6. Policy simulations and implications

- Two types of simulations:
  - *Ceteris paribus* analysis
    (single impact of each policy),
  - Sequential interaction analysis
    (cumulative impact of all policies).
- The 5 tested policies:
  - Scenario 1: *Entrance of a new low cost airline* (Easyjet airlines),
  - Scenario 2: *NTV travel time reduction*,
  - Scenario 3: *Trenitalia and NTV reduce ticket price*,
  - Scenario 4: *Alitalia-Cai reduces ticket price*,
  - Scenario 5: *Trenitalia and NTV reduce travel time*.

Scenario 1: Entrance of a new low cost airline (Easyjet airlines)

» *Ceteris paribus* analysis:

Thanks mainly to the reduced travel time Easyjet has gained a considerable part of the rail operators (especially, Trenitalia), and thanks to the reduced travel cost has gained a considerable part of air passengers (especially, Alitalia-Cai).

Relevant inter and intramodal impacts.

Table 61 – Scenario 1: Air competition with the entrance of a new *low cost* airline (Easyjet Airlines)

Parameters	Trenitalia	NTV	Alitalia-Cai	Ryanair	Easyjet
Total travel time	3 h 40'	4 h 5'	3 h 10'	5 h	3 h 10'
Time travel cost	80€	104€	150€	89€	60€
Delay	4'	4'	10'	7'	10'
ASC – Trenitalia	1	-	-	-	1
ASC – NTV	-	1	-	-	-
ASC – FSC	-	-	1	-	-
ASC – LCC	-	-	-	1	-
Market share:	**27%**	**13%**	**15%**	**6%**	**39%**
Variation (%) respect the Base case scenario:	-18%	-7%	-10%	-3%	-

Source: own elaboration

Scenario 2:
NTV travel time reduction

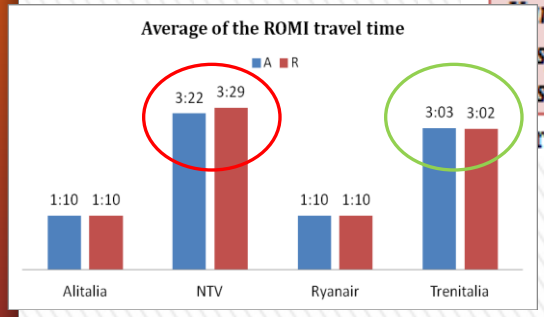
» *Ceteris paribus* analysis:

Inter and intramodal impacts.

Table 62 – Scenario 2 - Rail travel time reduction: NTV reduces travel time

Parameters	Trenitalia	NTV	Alitalia-Cai	Ryanair
Total travel time	3 h 40'	3 h 40'	3 h 10'	5 h
Time travel cost	80€	104€	150€	89€
Delay	4'	4'	10'	7'
ASC – Trenitalia	1	-	-	-
ASC – NTV	-	1	-	-
ASC – FSC	-	-	1	-
ASC – LCC	-	-	-	1
Market share:	**42%**	**26%**	**23%**	**9%**
riation (%) spect the Base se scenario:	-3%	+6%	-2%	-

rce: own elaboration



Source: own elaboration on an *ad hoc* survey

Scenario 3:

Trenitalia and NTV reduce ticket price

» *Ceteris paribus* analysis:

Discounts, promotions and other marketing activities by providing discount tickets.

Inter and intramodal impacts.

Table 63 - Aggressive high speed rail prices competition: Trenitalia and NTV reduce ticket price

Parameters	Trenitalia	NTV	Alitalia-Cai	Ryanair
Total travel time	3 h 40'	4 h 5'	3 h 10'	5 h
Time travel cost	65€	89€	150€	89€
Delay	4'	4'	10'	7'
ASC – Trenitalia	1	-	-	-
ASC – NTV	-	1	-	-
ASC – FSC	-	-	1	-
ASC – LCC	-	-	-	1
Market share:	49%	22%	21%	8%
Variation (%) respect the Base case scenario:	+4%	+2%	-4%	-1%

Source: own elaboration

Scenario 4:
Alitalia-Cai reduces ticket price

» *Ceteris paribus* analysis:

Alitalia-Cai has changed her ticket system
(from 44 different fares to 5 fixed fares)

Inter and
intramodal impacts

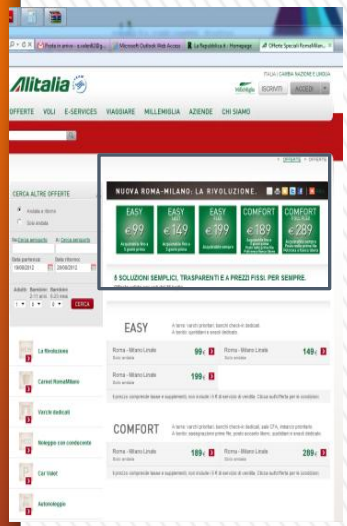


Table 64 - Scenario 4 - Air travel price reduction: Alitalia-Cai reduces ticket price

Parameters	Trenitalia	NTV	Alitalia-Cai	Ryanair
Total travel time	3 h 40'	4 h 5'	3 h 10'	5 h
Time travel cost	80€	104€	100€	89€
Delay	4'	4'	10'	7'
ASC – Trenitalia	1	-	-	-
ASC – NTV	-	1	-	-
ASC – FSC	-	-	1	-
ASC – LCC	-	-	-	1
Market share:	**32%**	**14%**	**48%**	**7%**
Variation (%) respect the Base case scenario:	-13%	-6%	+23%	-2%

Source: own elaboration

Scenario 5:
Trenitalia and NTV reduce travel time

» *Ceteris paribus* analysis:

Inter and
intramodal impacts.

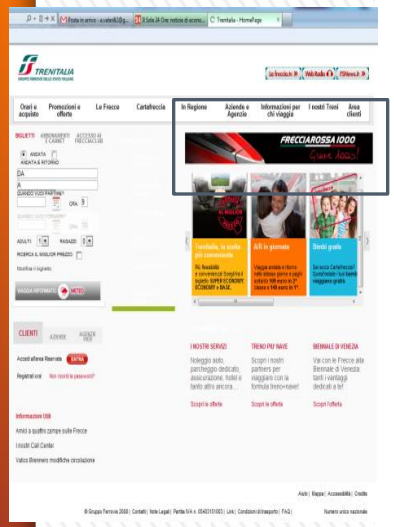


Table 65 – Rail travel travel time reduction: Trenitalia and NTV reduce travel time

Parameters	Trenitalia	NTV	Alitalia-Cai	Ryanair
Total travel time	2 h 30'	2 h 55'	3 h 10'	5 h
Time travel cost	80€	104€	150€	89€
Delay	4'	4'	10'	7'
ASC – Trenitalia	1	-	-	-
ASC – NTV	-	1	-	-
ASC – FSC	-	-	1	-
ASC – LCC	-	-	-	1
Market share:	56%	26%	13%	5%
Variation (%) respect the Base case scenario:	+11%	+6%	-12%	-4%

Source: own elaboration

Scenarios from 1 to 5:

» *Sequential interaction analysis:*

Table 66 – Synthesis of the sequential interaction analysis of the 5 selected policies

Selected policies	Trenitalia	NTV	Alitalia-Cai	Ryanair	Easyjet
Base case scenario:	45%	20%	25%	9%	-
Step 1 ***(market entry of Easyjet):***	27%	13%	15%	6%	39%
Step 2 ***(NTV travel time reduction):***	26%	16%	15%	5%	37%
Step 3 ***(Trenitalia & NTV ticket price reduction):***	31%	19%	13%	5%	32%
Step 4 ***(Alitalia-Cai ticket price reduction):***	25%	16%	28%	4%	27%
Step 5 ***(Trenitalia & NTV travel time reduction)***	41%	19%	19%	3%	18%

Source: own elaboration

Notes: the percentage highlighted in a different colour indicates the operator who has adopted a policy change.

7. Conclusion

- Total travel **time** and **cost** are the main important attributes, but more focus on the qualitative attributes,
- The estimated **Ro-Mi market shares** are:
  Trenitalia 45%, NTV 20%, Alitalia-Cai 25%, Ryanair 9%,
- The **most effective business strategies** for HSR transport operators are *travel time reduction* while for Alitalia-Cai is *fare reduction*,
- Own and cross-point elasticities indicate that air and rail transport should be considered as **substitutes** and belong to the **same relevant market**.

Thank you for your attention!

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