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A stated preference survey for airport choice modeling.

An application to an Italian multi-airport region

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Outline

- Study Context
- Research questions
- Related literature
- Methodology and Data description
- Econometric results and Catchment area definition
- Conclusions and Future research

Study context

- Regional airports play an important role both in term of accessibility and connectivity
- Multi-airport regions constitute a common and relevant aspect of European transport networks
- There is a long standing, even if relatively small, research tradition concentrating on airport choice

Research questions

1. Which are the most relevant attributes explaining airport choice probabilities in multi-airport regions?
2. Is there evidence that different attributes have varying explanatory power in alternative airports?
3. Are average part-worth utilities statistically different for specific market segments?
4. Is the variance of the means statistically different from zero (heterogeneity)?
5. Which is the kernel distribution for single agents' parameters?
6. Which are the catchment areas of the airports?

Related literature

Works	Sample size / choice ex . / n° alternatives	Attributes	Model
Bradley (1998)	985 / 11 / 2	-Airport -Air fare -Flight frequency-Access time - Access mode (5)	Binary logit
Adler et al. (2005)	600 / 10 / 3	-Airport -Airline -Access time - Flight times -Connectivity -Air fare-Schedule delay -Aircraft type-Probability to be on time-Frequent flyer benefits (10)	Mixed logit
Hess et al. (2007)	600 / 10 / 2	-Airport -Airline -Access time - Flight times -Connectivity -Air fare-Schedule delay -Aircraft type-Probability to be on time-Frequent flyer benefits (10)	Binary logit
Loo (2008)	308 / 2 / 8	-Airport -Access mode - Access time -Access cost - Number of airlines -Flight frequency-Air fare -Shopping areas-Check in delays (9)	Multinomial logit

Methodology

Methodology

- Focus groups and previous studies (Gatta & Marcucci, submitted to JTG) were the base for attribute (number, level and range) selection;
- 1.500 CAPI interviews were administered at the 4 airports studied (BO, FO, RN,AN);
- Agents were randomly selected within the airport sterile area among departing passengers;
- Departing passengers were: (1) first asked some questions concerning their present behavior, perceptions and socio-economic characteristics; (2) subsequently, were asked to choose among four hypothetical alternative characterizations of the above mentioned airports.

Methodology (cont.d)

- Actual choices (Revealed Preference) were acquired (1.379 choices)
- Conjoint stated choice experiments were administered (6.839 exercises)
- Design:
  - Orthogonal
  - Full profile
  - Fractional factorial (900 sets = 5 rept. X 180 blocks - 38 times design covered)
  - Minimal overlap

Methodology (cont.d)

Attribute	Levels	Range
Airport	4	AN,BO,FO,RN
Access cost	3	10,20,30 (€)
Access time	5	30,60,90,120,150 (min.)
Airline	2	Preferred/Otherwise
Ticket price	5	50,100,150,200,250 (€)
Flight type	2	Direct/Otherwise
Schedule delay	3	+/- 1,3,6 (h.)

Data description

Data description

		Origin airport				
		AN	BO	FO	RN	Total
Age	mean	38.98	38.49	35.27	38.75	**38.09**
	St.Dev	11.59	11.01	12.16	10.61	**11.40**
Income (monthly)	mean	2,514.89	2,537.85	1,255.95	2,044.12	**2,205.58**
	St.Dev	2,217.52	2,198.43	1,027.98	1,856.37	**2,034.44**
N° of flights from AN (last year)	mean	5.51	.20	.25	.18	**1.76**
	St.Dev	7.99	1.06	.60	.56	**5.00**
N° of flights from BO (last year)	mean	1.23	7.18	.45	1.12	**3.09**
	St.Dev	2.92	9.67	.80	3.40	**6.73**
N° of flights from FO (last year)	mean	.24	.47	1.53	.35	**.57**
	St.Dev	.89	1.61	1.20	.80	**1.30**
N° of flights from RN (last year)	mean	.17	.10	.10	2.65	**.59**
	St.Dev	.62	.66	.34	4.70	**2.31**

Data description (cont.d)

		Origin airport				
		AN	BO	FO	RN	Total
Access time (minute)	mean	44.83	51.49	51.84	19.82	**43.75**
	St.Dev	31.98	39.73	36.96	15.98	**35.62**
Access cost (€)	mean	20.92	21.33	15.51	7.62	**17.61**
	St.Dev	21.52	23.54	13.25	8.31	**19.88**
Ticket cost (€)	mean	325.06	366.02	68.41	309.16	**289.15**
	St.Dev	353.63	462.85	30.48	185.95	**356.59**
Balance (minute)	mean	113.79	77.77	120.58	93.25	**98.98**
	St.Dev	136.78	128.58	160.24	122.08	**137.13**

Econometric results

Econometric results - MNL -Rq1: main attributes

Variable	*Coeff*	*Sig*	*Coeff*	*Sig*	*Coeff*	*Sig*	*Coeff*	*Sig*	*Coeff*	*Sig*
AN	-0,5291	**	-0,0743	***	-0,0758	***	-0,0587	**	-0,0408	*
FO	-0,8046	***	-0,0474	**	-0,0412	*	-0,0390	*	-0,0525	**
RN	0,0568	**	0,0901	***	0,0958	***	0,1228	***	0,1257	***
GC	-0,1822	***	-0,0185	***	-0,0185	***	-0,0185	***	-0,0186	***
AIRLINE	0,1103	***	0,1116	***	0,1118	***	0,1137	***	0,1144	***
TICK. COST	-0,0077	***	-0,0079	***	-0,0079	***	-0,0079	***	-0,0079	***
NONSTOP	0,7151	***	0,7247	***	0,7248	***	0,7257	***	0,7298	***
BALANCE	-0,0019	***	-0,0019	***	-0,0019	***	-0,0019	***	-0,0019	***
INERTIA			0,4738	***	0,4408	***	0,2965	***	0,2903	***
FREQUENCE					0,0079	**	0,0077	**	0,0064	*
NEVER							-0,2311	***	-0,5212	***
K_AIRPORT									-0,3899	***
LL ***LL Ratio Test***	*-7850,290 /* *Pass*		*-7721,275 /* *Pass*		*-7718,873 /* *Pass*		*-7704,824 /* *Pass*		*-7681,959 /* *Pass*	
Adj RHO2	*0,1701*		*0,1836*		*0,1837*		*0,1851*		*0,1874*	

Econometric results: MNL - Rq2: Do different attributes have varying explanatory power in alternative airports?

	AN		BO		FO		RN	
Variable	*Coeff*	*Sig*	*Coeff*	*Sig*	*Coeff*	*Sig*	*Coeff*	*Sig*
GC	-0,0160	***	-0,0189	***	-0,0193	***	-0,0206	***
AIRLINE	0,1137	*	0,0966		0,1117	*	0,1334	**
TICKET COST	-0,0082	***	-0,0075	***	-0,0084	***	-0,0078	***
NONSTOP	0,5889	***	0,7707	***	0,8255	***	0,7358	***
BALANCE	-0,0023	***	-0,0014	***	-0,0023	***	-0,0021	***
INERTIA	0,4948	***	0,4396	***	-0,2425	**	0,3259	***
FREQUENCE	-0,0026		0,0055		0,0047	**	0,0121	
NEVER	-0,6138	***	-0,2063		-0,6048	***	-0,5454	***
K_AIRPORT	-0,4460	***	-0,2206		-0,4490	***	-0,3299	***
AIRPORT	-0,0508		-		0,1360		0,2316	*
LL / LL Ratio Test	*-7640,293 / Pass*							
Adj RHO2	*0,1886*							

Econometric results (MNL) -Rq3: Are average part-worth utilities statistically different for specific market segments?

Interaction with SEX (variable*male)

Variable	*Coeff*	*Sig*	*Interact*	*Sig*
AN	-0.0747	*	0.0540	
FO	-0.0169		-0.0546	
RN	0.1170	***	0.0137	
FREQUENCE	-0.0155		0.0243	**
NEVER	-0.3875	***	-0.2207	*
INERTIA	0.3256	***	-0.0448	
K_AIRPORT	-0.2486	**	-0.2217	*
GC	-0.0163	***	-0.0036	***
AIRLINE	0.1219	***	-0.0126	
TICKET COST	-0.0093	***	0.0021	***
NONSTOP	0.7183	***	0.0234	
BALANCE	-0.0011	***	-0.0014	***
LL / LL Ratio Test	*-7641,853 / Pass*			
Adj RHO2	*0.1902*			

Econometric results (MNL) -Rq3: Are average part-worth utilities statistically different for specific market segments?

Interaction with AGE

Variable	*Coeff*	*Sig*	*Interact*	*Sig*
AN	0.0184		-0.0017	
FO	-0.1087		0.0016	
RN	0.2384	***	-0.0030	
FREQUENCE	-0.0072		0.0003	
NEVER	0.3365		-0.0222	***
INERTIA	0.3537	**	-0.0013	
K_AIRPORT	0.3362	*	-0.0187	***
GC	-0.0147	***	-0.0001	*
AIRLINE	0.0069		0.0028	
TICKET COST	-0.0115	***	9.16E-05	***
NONSTOP	0.8144	***	-0.0020	
BALANCE	-0.0006		-3.60E-05	***
LL / LL Ratio Test	*-7639,189 / Pass*			
Adj RHO2	*0.1905*			

Econometric results (MNL) -Rq3: Are average part-worth utilities statistically different for specific market segments?

Interaction with INCOME

Variable	*Coeff*	*Sig*	*Interact*	*Sig*
AN	-0.0340		-4.25E-06	
FO	-0.0637	*	7.24E-06	
RN	0.1610	***	-1.73E-05	
FREQUENCE	0.0029		4.67E-08	
NEVER	-0.3180	***	-9.47E-05	***
INERTIA	0.2666	***	1.74E-05	
K_AIRPORT	-0.1777	**	-9.67E-05	***
GC	-0.0150	***	-1.73E-06	***
AIRLINE	0.1360	***	-1.03E-05	
TICKET COST	-0.0098	***	8.26E-07	***
NONSTOP	0.7015	***	1.82E-05	
BALANCE	-0.0014	***	-2.78E-07	***
LL / LL Ratio Test	*-7607,067 / Pass*			
Adj RHO2	*0.1939*			

Econometric results (MNL) -Rq3: Are average part-worth utilities statistically different for specific market segments? (RP data)

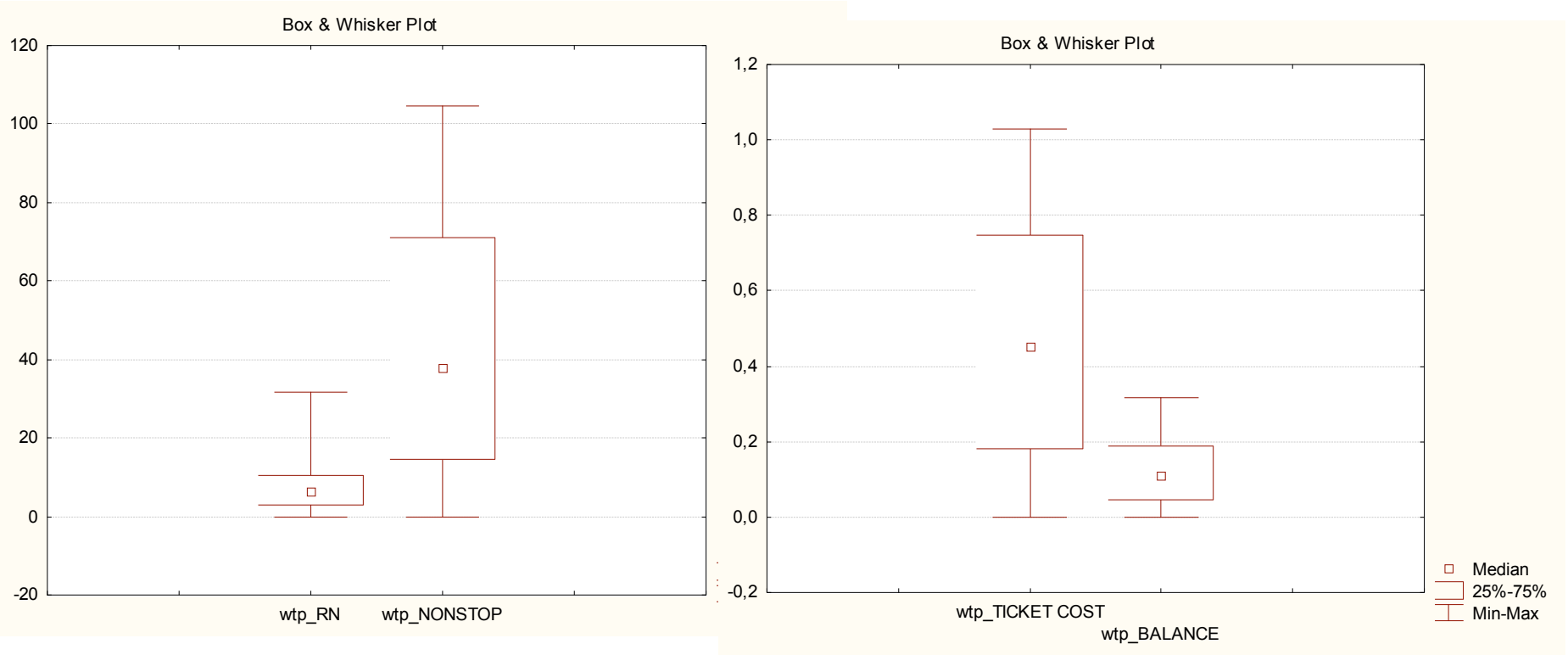
	AN		BO		FO		RN	
Variable	*Coeff*	*Sig*	*Coeff*	*Sig*	*Coeff*	*Sig*	*Coeff*	*Sig*
GC	-0.0241	***	-0.0244	***	-0.0195	***	-0.0513	***
AIRLINE	0.2746		0.7509	***	0.2818		0.8886	*
TICKET COST	0.0004		0.0014		-0.0235	***	0.0015	
NONSTOP	-0.0638		0.3834		1.2362		0.4760	
BALANCE	-0.0011		-0.0060	***	-0.0002		-0.0057	***
FREQUENCE	0.8964	***	0.4455	***	0.9124	***	1.8776	***
AIRPORT	0.4808		-		0.4165		-0.6409	
LL / LL Ratio Test	*-268.303 / Pass*							
Adj RHO2	*0,6897*							

Econometric results (MMNL) -Rq4: Is the variance of attributes' parameters statistically different from zero?

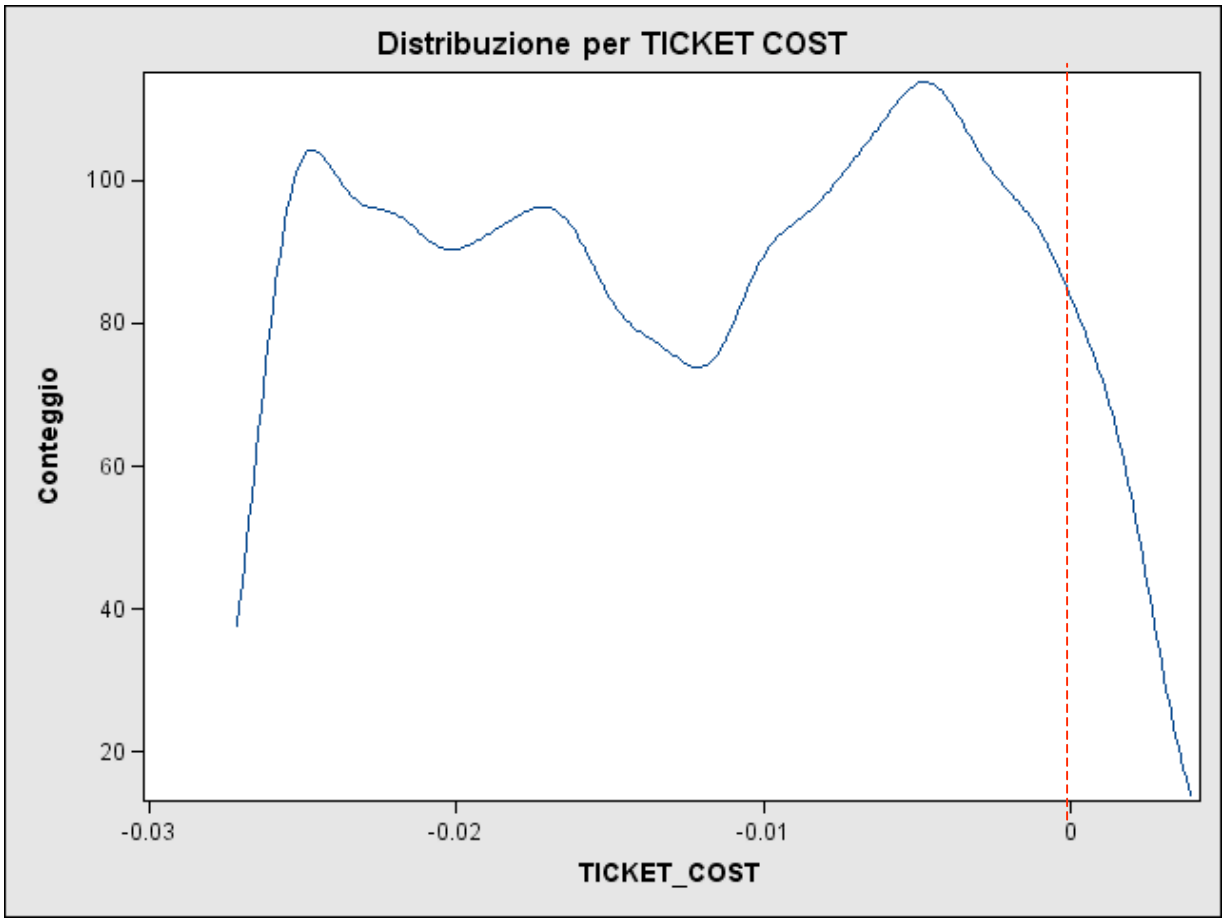
Variable	*β-coeff*	*Sig*	*St.Dev.-coeff*	*Sig*	*WTP (median)*
AN (fix)	-0.0559	*			2.12 €
FO (fix)	0.0027				
RN (rnd. N)	0.1366	***	0.4538	***	- 6.33 €
FREQUENCE (fix)	0.0103	*			
NEVER (fix)	-0.7265	***			
K_AIRPORT (fix)	-0.5349	***			
INERTIA (rnd. U)	0.3192	***	1.7947	***	
AIRLINE (fix)	0.1453	***			- 5.52 €
TICKET COST (rnd. U)	-0.0127	***	0.0194	***	0.45 €
NONSTOP (rnd. U)	1.1578	***	2.1270	***	- 37.90 €
BALANCE (rnd. U)	-0.0031	***	0.0070	***	0.11 € per min
GC (fix)	-0.0263	***			
LL	*-7187.637*				
LL Ratio Test	*Pass*				
Adj RHO2	*0.2391*				

Econometric results (MMNL) -Rq4: Is the variance of attributes' parameters statistically different from zero?

- Individual specific WTP

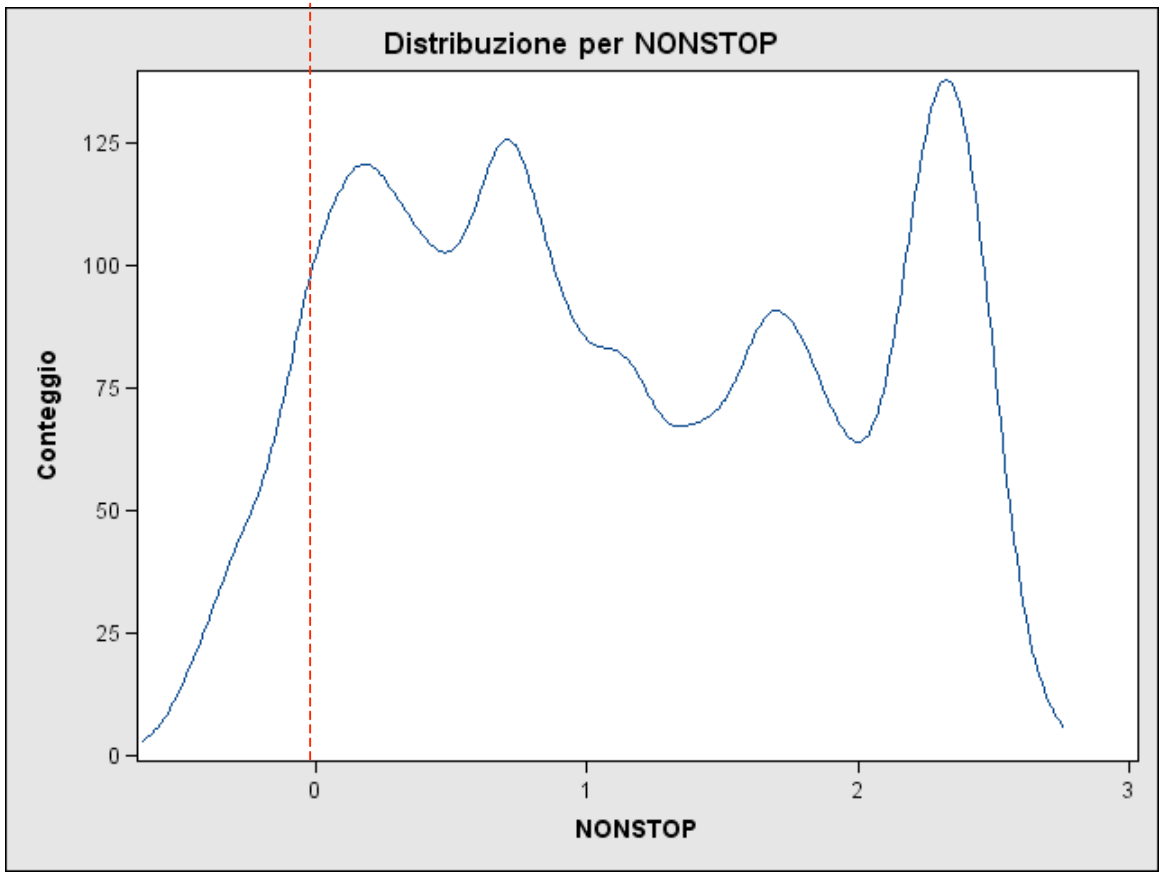


Econometric results (MMNL-kernel 1/5)
Rq5: kernel distribution for single agents' parameters



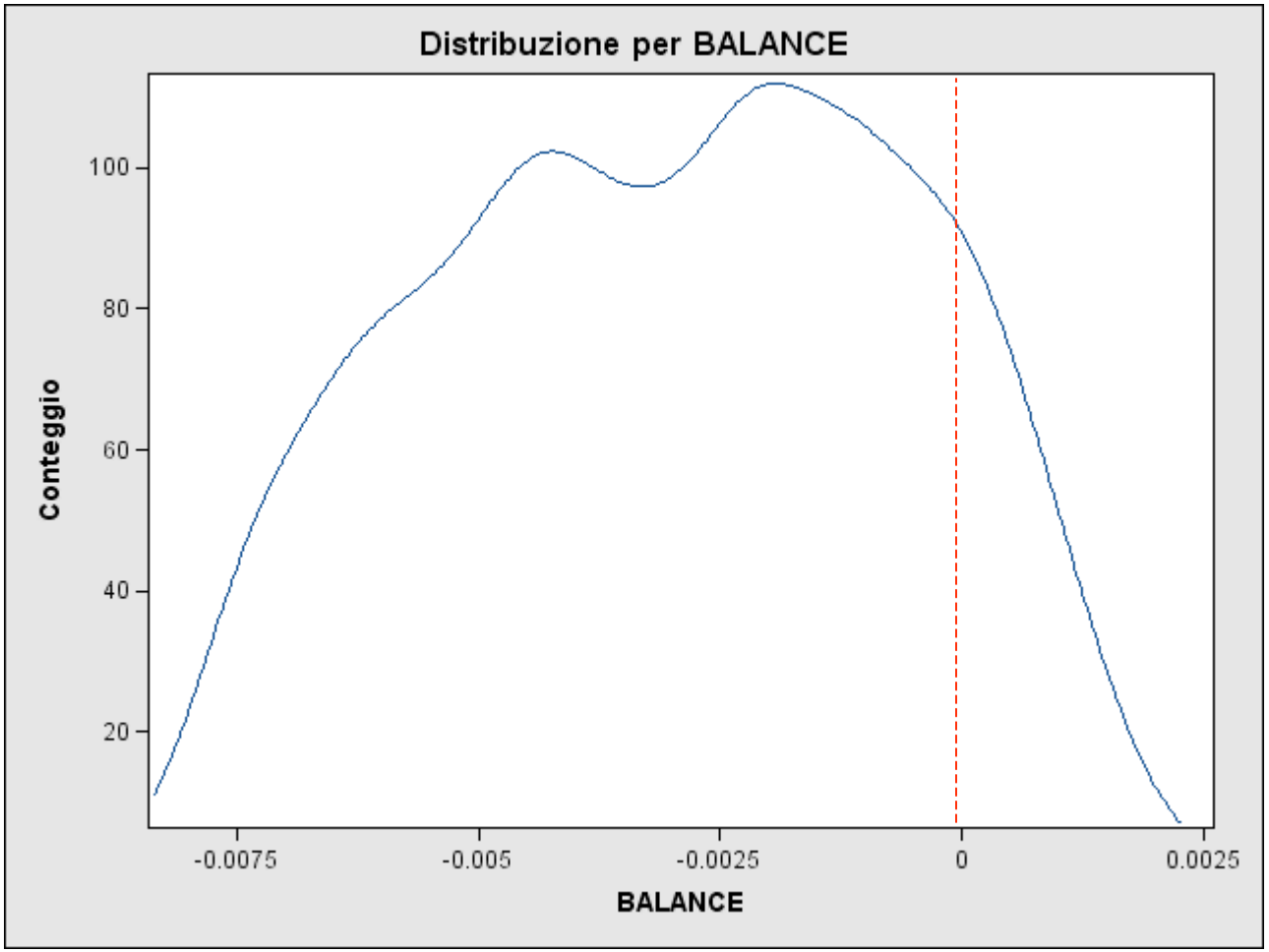
- Uniform distribution
- 93% of individual coefficients with expected sign.
- Coefficients with unexpected sign are all not significant

Econometric results (MMNL-kernel 2/5)
Rq5: kernel distribution for single agents' parameters



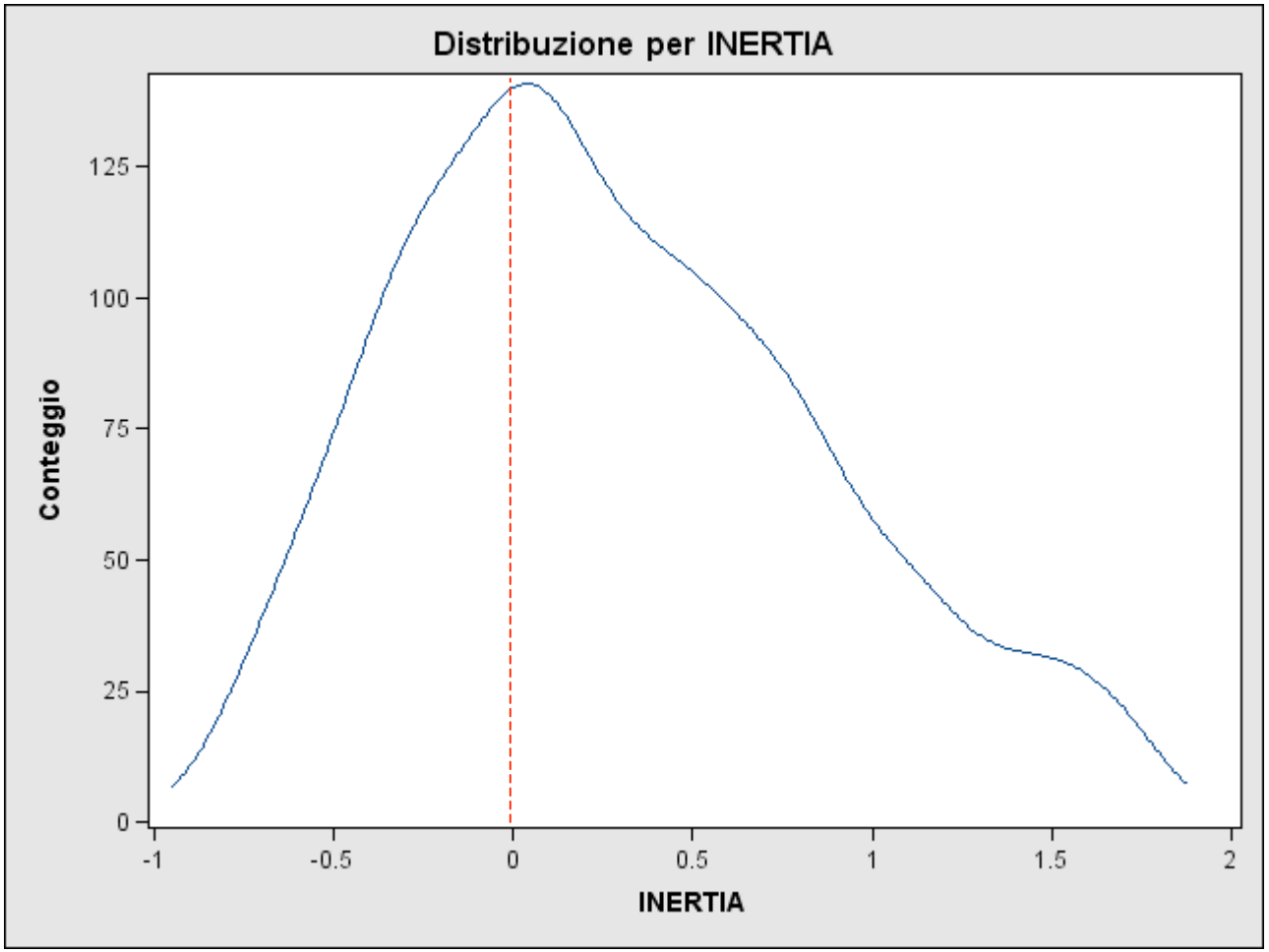
- Uniform distribution
- 91% of individual coefficients with expected sign.
- Coefficients with unexpected sign are all not significant

Econometric results (MMNL-kernel 3/5)
Rq5: kernel distribution for single agents' parameters



- Uniform distribution
- 88% of individual coefficients with expected sign.
- Coefficients with unexpected sign are all not significant

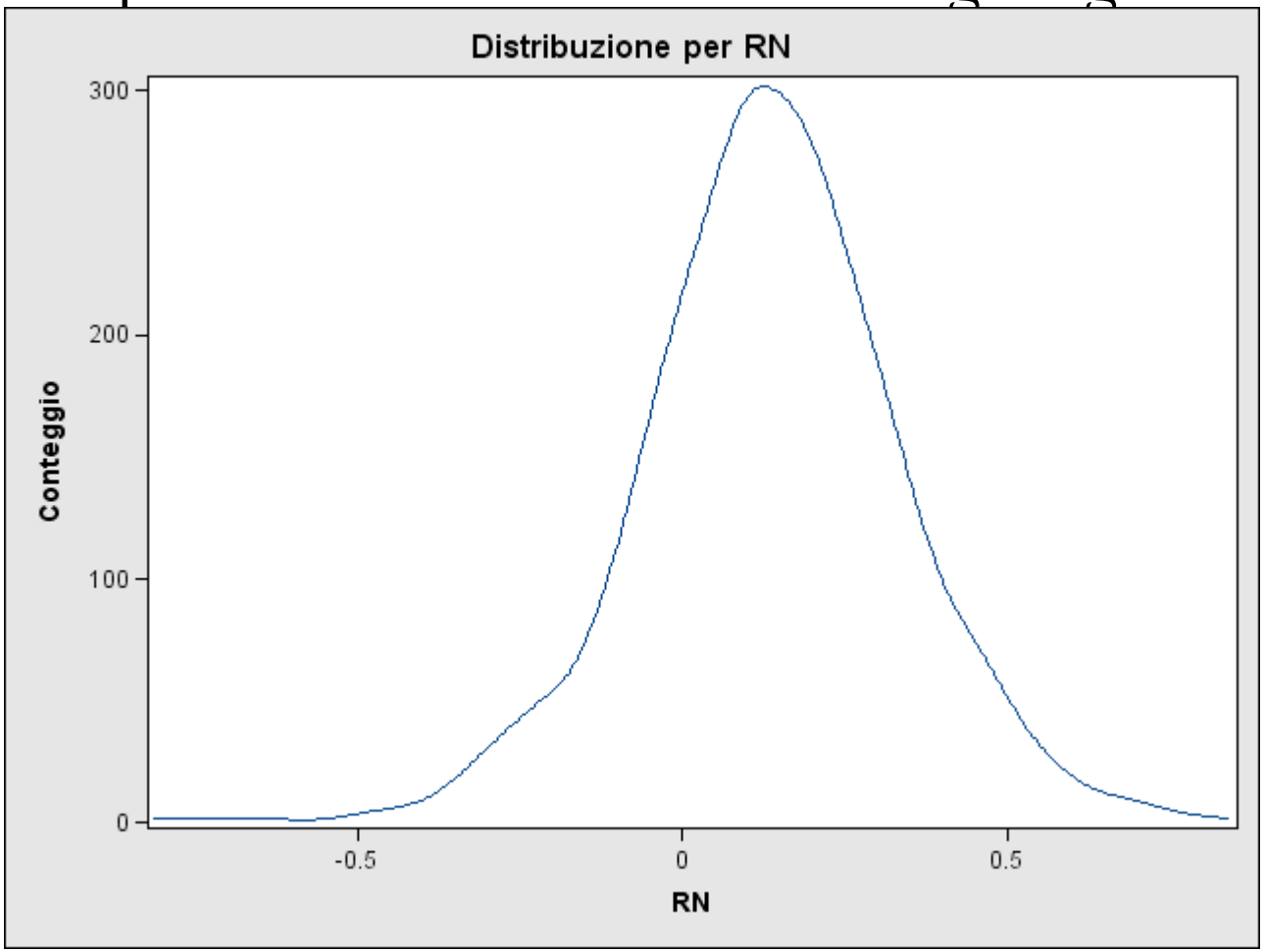
Econometric results (MMNL-kernel 4/5)
Rq5: kernel distribution for single agents' parameters



- Uniform distribution
- 65% of individual coefficients with expected sign.
- Coefficients with unexpected sign are all not significant

Econometric results (MMNL-kernel 5/5)

Rq5: kernel distribution for single agents' parameters

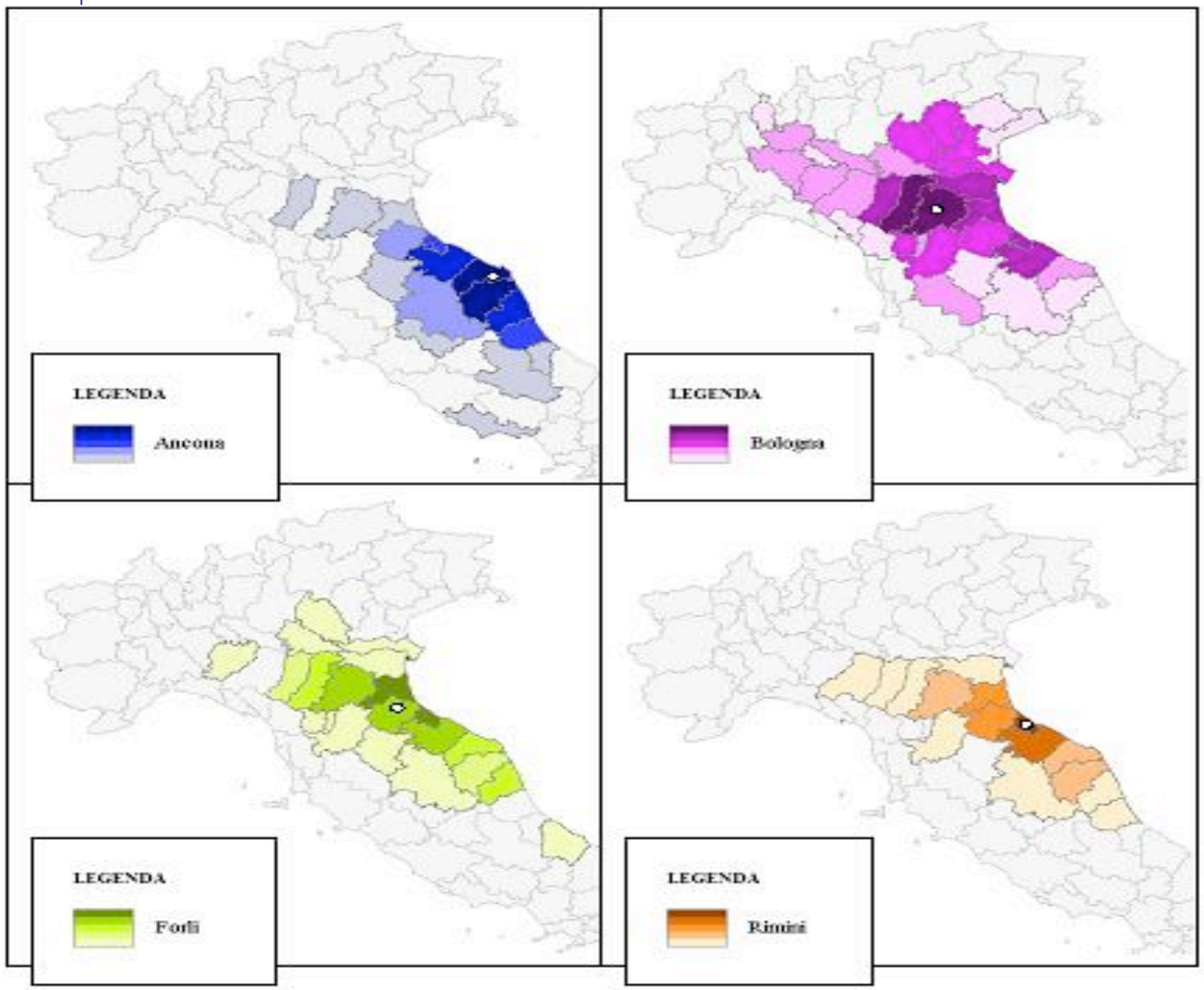


- Normal distribution
- No specific a priori

Catchment Areas

Airport catchment area

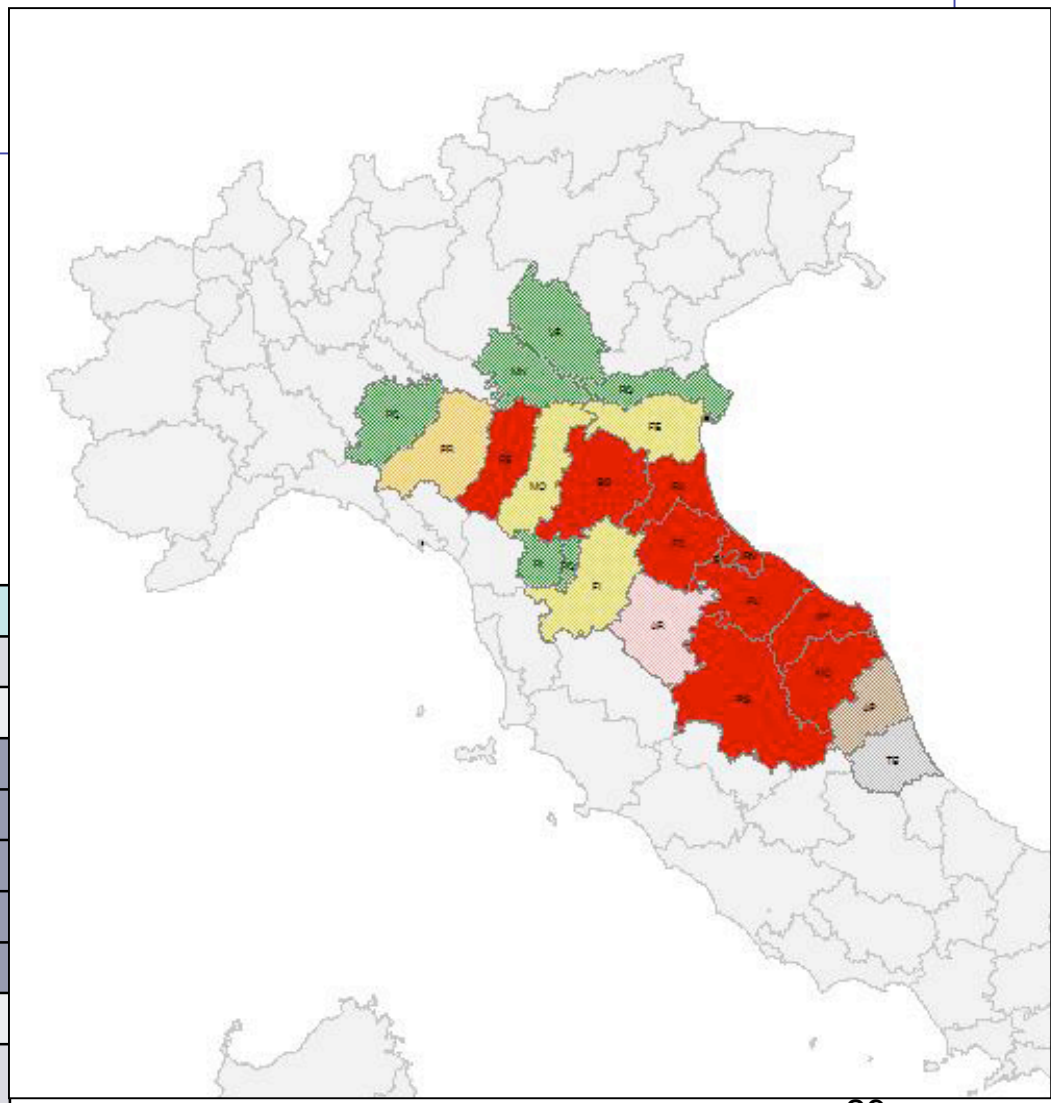
(1130 personal interviews at 4 four airports)



Potential customers
Ancona
6.370.323
Bologna
18.540.112
Forlì
9.280.324
Rimini
7.048.176

LEGENDA

- Aree di sovrapposizione fra Ancona, Bologna, Forlì e Rimini
- Aree di sofrapposizione fra Ancona, Forlì e Rimini
- Aree di sovrapposizione fra Bologna, Forlì e Rimini
- Aree di sovrapposizione fra Ancona, Bologna e Forlì
- Aree di sovrapposizione fra Bologna e Rimini
- Aree di sovrapposizione fra Bologna e Forlì
- Aree di sovrapposizione fra Ancona e Rimini



Overlapping regions

	Ancona	Rimini	Forlì	Bologna
Residents in common catchment areas	287.411			
	369.371			
			323.288	
			2.207.171	
		392.976		
		1.912.176		
	4.086.242			
Totale	5.066.312	7.048.176	8.997.248	8.921.853
% of airport catchment area	**79,53%**	**100%**	**96,95%**	**48,12%**

Conclusions

1. We individuated and estimated the most relevant attributes explaining airport choice
2. We brought evidence testifying that different attributes have varying explanatory power in alternative airports
3. We showed that average part-worth utilities are statistically different for specific sample segments
4. We proved that the variance of some parameters are statistically different from zero
5. We reported the kernel distribution for single agents' parameters
6. We described the catchment area of each airport

Future research

- Estimate the effects of probabilistic alternative assignment to individuals' choice sets
- Estimate market shares redistributions when changing relevant attributes (RP & SP merging)
- Capture different forms of heterogeneity by testing: (1) heterogeneity in parameters' variance; (2) specify error component ML models to detect potential correlation among alternative attribute utilities; (3) verify if LC models have a better explanatory power when socioeconomic and probabilistic choice set formation is introduced.

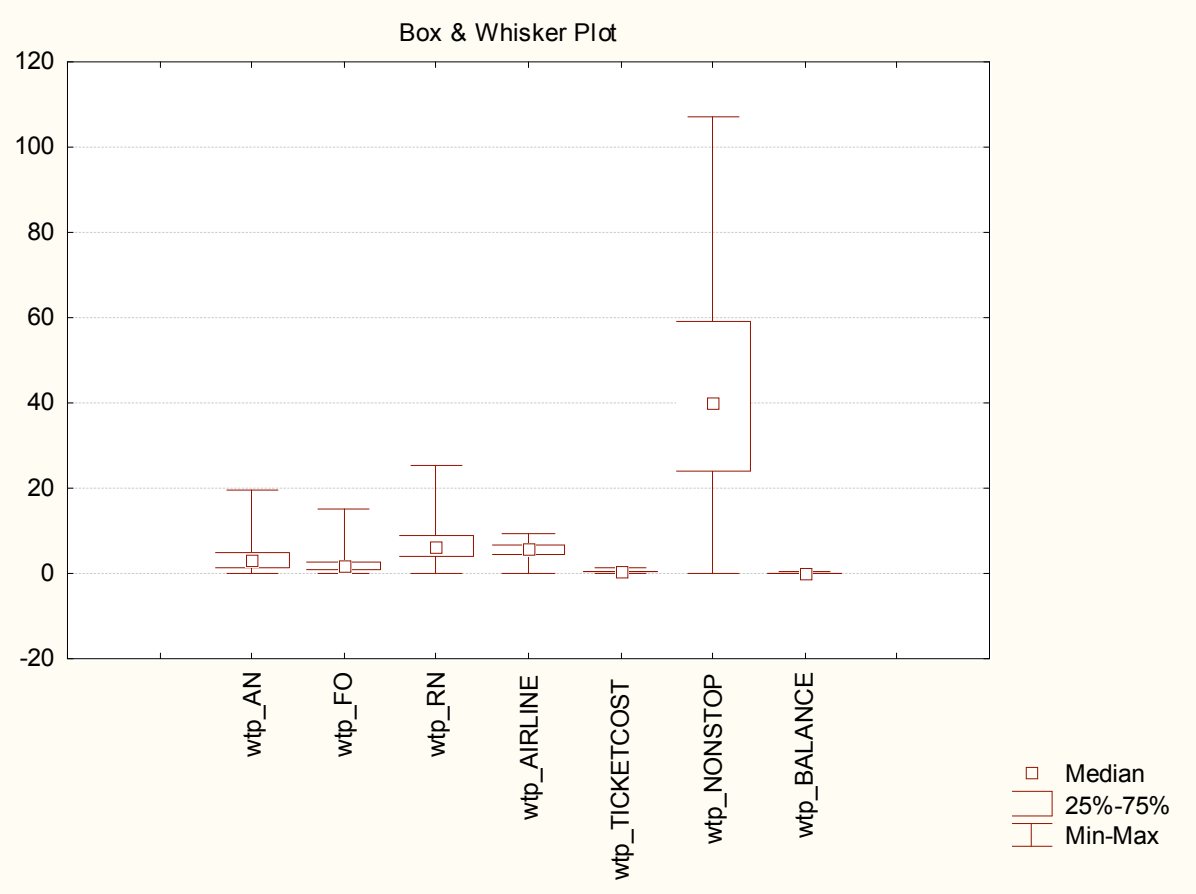
Thanks for your attention!

- Questions?
  - Questions?
    - Questions?
      - Questions?
        - Questions?

Econometric results (MMNL 2/2)

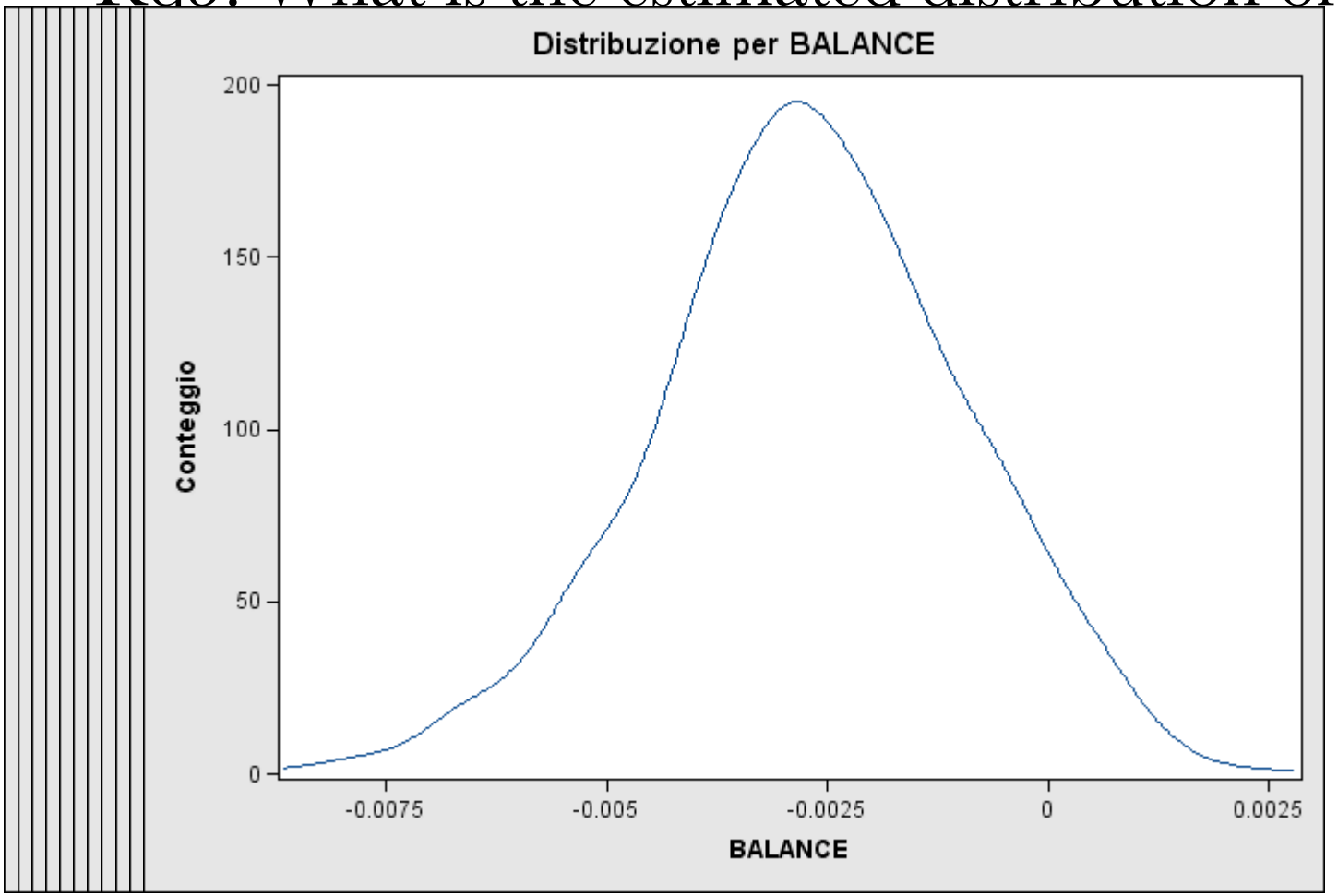
Rq4: Is the variance of attributes' parameters statistically different from zero (within sample)?

Individual specific WTP



Econometric results (MMNL - kernel)

Rq5: What is the estimated distribution of the



Econometric results: MMNL

Rq4: Is the variance of attributes' parameters statistically different from zero (within sample)?

Variable	*β-coeff*	*Sig*	*St.Dev.-coeff*	*Sig*	*WTP*
AN	**-0.0628**	*	**0.2569**	***	**3,52**
FO	**-0.0276**		**0.2041**	***	**1,97**
RN	**0.1550**	***	**0.2852**	***	**6,64**
FREQUENCE	**0.0063**		**0.0102**		
NEVER	**-0.6585**	***	**0.0187**		
K_AIRPORT	**-0.4704**	***	**0.2483**		
INERTIA	**0.2905**	***	**0.9775**	***	
AIRLINE	**0.1404**	***	**0.0914**		**5,60**
TICKET COST	**-0.0107**	***	**0.0101**	***	**0,48**
NONSTOP	**1.0296**	***	**0.9457**	***	**42,13**
BALANCE	**-0.0027**	***	**0.0028**	***	**0,11**
GC	**-0.0245**	***			
LL ***LL Ratio Test***	*-7269.252* *Pass*				
Adj RHO2	*0.2298*				

Econometric results - Variables description

Variable	Description
AN	Effect coding for Ancona airport (1; 0; -1 if Bologna)
FO	Effect coding for Forlì airport (1; 0; -1 if Bologna)
RN	Effect coding for Rimini airport (1; 0; -1 if Bologna)
GC	Generalized cost in €
AIRLINE	1=preferred airline; 0=any airline
TICKET COST	Ticket cost in €
NONSTOP	1=non-stop flight; 0=stop flight
BALANCE	Gap between actual and wished departure time in minute (absolute value)
INERTIA	1=the specified airport is the last airport chosen
FREQUENCE	Number of flights from the specified airport during the last 12 months
NEVER	1=have never flown from the specified airport; 0=have flown from the specified airport
K_AIRPORT	1=would never fly from the specified airport; 0=would fly from the specified airport
SEX	1=male; 0=female
AGE	N° of year
OCCUPATION	1=empl. full time; 2=self-empl. worker; 3=student; 4=other
INCOME	Monthly income in €
DESTINATION	1=domestic flight; 0=international flight
TRIP PURPOSE	1=business; 2=other

Methodology (cont.d)

- Discrete choice models
- RUM framework
- Different model specification:
  - MNL
    - attribute generic/specific
    - segmentation by variable interactions (socioeconomic)
  - MMNL (random parameter specification)
  - Individual-specific MMNL
- Estimates produced
  - Attribute coefficients and WTP
  - Individual specific attribute coefficients and WTP

Data description (cont.d)

		Origin airport				
		AN	BO	FO	RN	Total
Departed from AN	yes	100,0%	13,2%	35,3%	22,0%	**44,2%**
	never	,0%	86,8%	64,7%	78,0%	**55,8%**
Departed from BO	yes	60,0%	100,0%	65,9%	69,0%	**76,4%**
	never	40,0%	,0%	34,1%	31,0%	**23,6%**
Departed from FO	yes	26,1%	33,7%	100,0%	39,2%	**44,6%**
	never	73,9%	66,3%	,0%	60,8%	**55,4%**
Departed from RN	yes	24,8%	13,6%	17,5%	100,0%	**33,6%**
	never	75,2%	86,4%	82,5%	,0%	**66,4%**
Would ever depart from AN	yes	100,0%	53,5%	65,1%	39,2%	**66,6%**
	no	,0%	46,5%	34,9%	60,8%	**33,4%**
Would ever depart from BO	yes	71,7%	100,0%	75,8%	71,8%	**82,1%**
	no	28,3%	,0%	24,2%	28,2%	**17,9%**
Would ever depart from FO	yes	46,7%	52,5%	100,0%	47,5%	**58,5%**
	no	53,3%	47,5%	,0%	52,5%	**41,5%**
Would ever depart from RN	yes	42,9%	40,3%	50,4%	100,0%	**54,0%**
	no	57,1%	59,7%	49,6%	,0%	**46,0%**

Econometric results (coding)

- Effects coding for AIRPORT attribute

Levels	Variables		
	AN	FO	RN
Ancona	1	0	0
Forlì	0	1	0
Rimini	0	0	1
Bologna	-1	-1	-1

- Significance

blank	Not statistically significant
*	Significance at 10%
**	Significance at 5%
***	Significance at 1%

Data description

		Origin airport				
		Ancona (AN)	Bologna (BO)	Forlì (FO)	Rimini (RN)	Total
Gender	female	35,2%	28,6%	38,9%	42,4%	**35,0%**
	male	64,8%	71,4%	61,1%	57,6%	**65,0%**
Occupation	employed full time	58,1%	61,2%	48,4%	48,2%	**55,5%**
	self-employed worker	22,1%	25,2%	16,7%	32,5%	**24,1%**
	student	12,9%	9,2%	24,6%	7,1%	**12,7%**
	other	6,9%	4,5%	10,3%	12,2%	**7,7%**
Destination	international flight	72,5%	60,8%	62,7%	53,7%	**63,2%**
	domestic flight	27,5%	39,2%	37,3%	46,3%	**36,8%**
Trip purpose	business	55,3%	68,9%	23,0%	48,6%	**52,8%**
	leisure	22,6%	14,3%	32,1%	20,4%	**21,1%**
	visiting friends/relatives	20,1%	11,1%	42,1%	29,8%	**22,8%**
	other	2,0%	5,8%	2,8%	1,2%	**3,3%**
Flight type	direct	53,8%	67,0%	98,8%	80,8%	**71,5%**
	otherwise	46,2%	33,0%	1,2%	19,2%	**28,5%**
Airline	preferred	49,6%	49,9%	52,0%	40,4%	**48,4%**
	otherwise	50,4%	50,1%	48,0%	59,6%	**51,6%**