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SOCIO-ECONOMIC DETERMINANTS OF THE POTENTIAL DEMAND FOR CARSHARING.

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- Research question
- Literature review
- The sample
- Results
- Conclusions and future research

Research question: premises

- In Italy there is an increasing supply and demand of carsharing (CS)
  - CS is offered
    - by private companies (Car2Go,EnJoy, Twist) in
      - Milan; Rome; Turin; Florence; Bologna; Genoa;
    - and via municipal initiatives (Iniziativa Car Sharing) in many other cities
      - Brescia; Savona; Padua; Palermo; Parma; Venice
        - beside Milan; Rome; Turin; Florence; Bologna; Genoa;
    - in Milan there are 6 providers
      - GuidaMi; E-vai; Car2Go; Enjoy; Twist; Share'nGo (EqSharing)
  - In 2014, in Italy, CS users were 220.000 (80% in Milan)
    - +70% with respect to 2013

Research question

- Is there a potential demand for CS in FVG?
- What are the socio-economic determinants of this potential demand?

Literature review

- Increasing literature on CS
  - description of CS growth
  - administrative and logistical issues of running a CS service
  - characteristics of CS users and uses (travel purpose)
  - impacts on car ownership, distance travelled and parking demand

Recent literature on CS demand estimation

- Schuster et al. (2005)
  - Monte Carlo simulation of the economic decision of owning or sharing a car based on major cost components and past car use
- Duncan (2010)
  - comparison of the estimated cost of using a CS and a private car
- Ciari et al. (2013 and 2014)
  - activity-based microsimulation
- Le Vine *et al.* (2014)
  - pooled data from the British National Travel Survey and a revealed and a stated-choice survey

The sample

- 1276 people
  - 694 women; 582 men
- Age:
  - 49% 18 – 25; 43% 25 - 65 anni; 8% over 65.
- Province of residence:
  - GO 36%; TS 35%; UD 12%; PN 8%; 9% other regions.
- City size:
  - 33% TS; 5% PN; 3% UD; 33% <20k inhabitants; 25 % 20k – 50k.
- Income:
  - 27% <€2k, 49% €2k - €4k, 14% >€4k, 10% missing.

Methodology and results

- Interviews:
  - telephone, face-to-face, social networks
- Data collected:
  1. Would you use a CS service if available?
     - rating scale from 1 (undoubtedly no) to 5 (certainly yes)
  2. Assume that you don't have a car but a CS is available, how would you change your mobility pattern of commuting and non-commuting trips?

- no data provided for CS service (fares, location, type of cars, type of service….)

	N° of round trip journeys	Average distance per journey
	Current *COMMUTING* trips per week	
Car*		
Motor bike		
Bus		
Train		
Taxi *		
Walking		
Bicycle		
	Hypothetical *COMMUTING* trips per week	
Carsharing*		
Motor bike		
Bus		
Train		
Taxi *		
Walking		
Bicycle		

	N° of round trip journeys	Average distance per journey
	Current *NON-COMMUTING* trips per week	
Car*		
Motor bike		
Bus		
Train		
Taxi *		
Walking		
Bicycle		
	Hypothetical *NON-COMMUTING* trips per week	
Carsharing*		
Motor bike		
Bus		
Train		
Taxi *		
Walking		
Bicycle		

Stated willingness to use CS
- rating scale 1-5 -

- No (1-2): 66% Maybe (3): 18% Yes (4-5): 16%

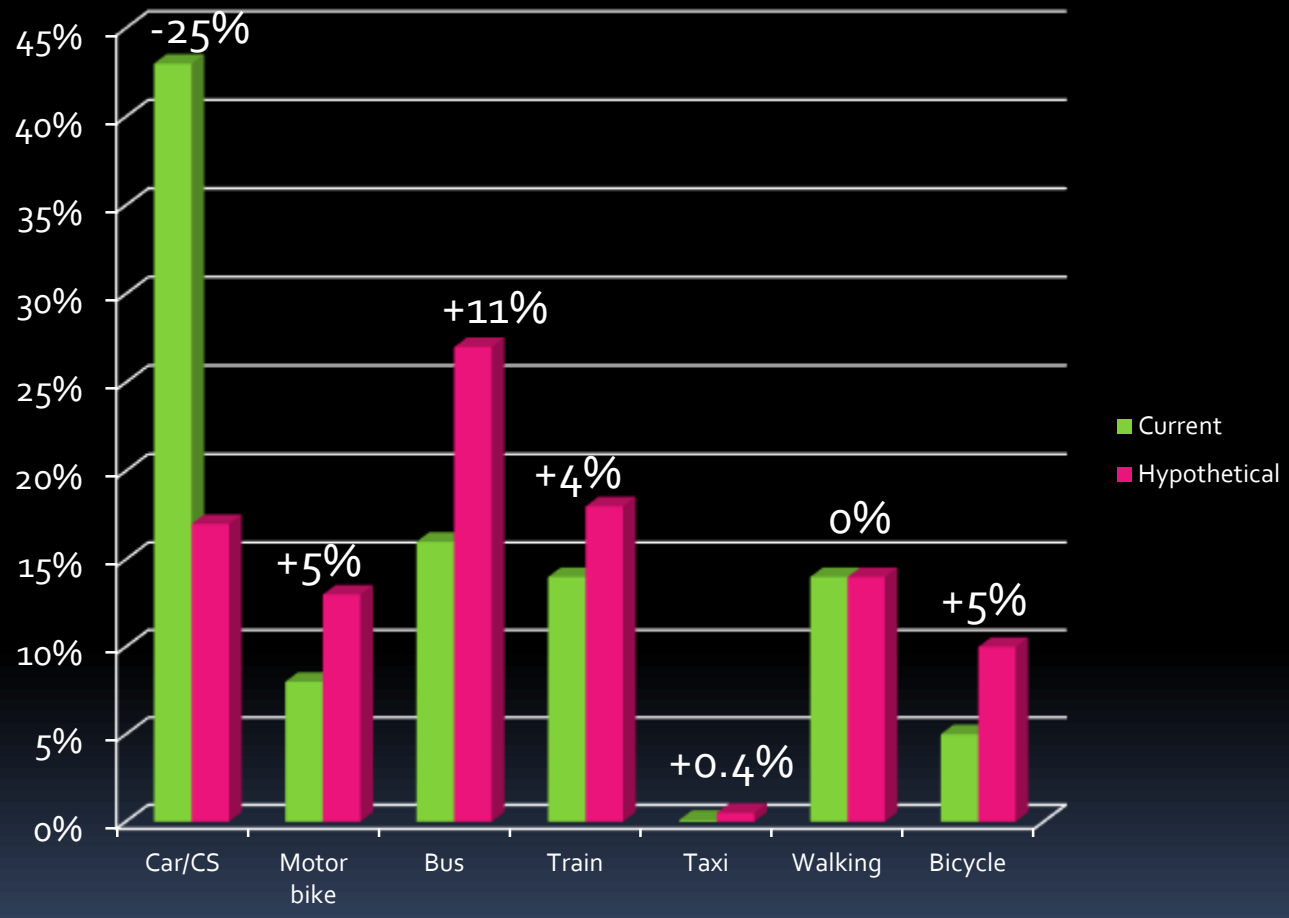
Ordered logit of Stated Willingness to use CS	Coeff.	Std.Err.	t-ratio	P-value
ONE	-1.16	0.29	-3.94	0.00
Age: 1 "18-25"; 2 "25-65"; 3 ">65" (ordinal)	-0.74	0.11	-6.46	0.00
City size: 20k-50k inhabitants (dummy)	-1.17	0.15	-8.03	0.00
Retired (dummy)	-1.43	0.42	-3.39	0.00
Unemployed (dummy)	2.14	0.55	3.87	0.00
N. Commuting trips: 0 "0"; 1 "1-10"; 2 "11-20"; 3 ">20"(ordinal)	0.35	0.09	3.89	0.00
Environmental awareness (ordinal, 1 to 5)	0.45	0.06	7.95	0.00
CS knowledge (ordinal , 1 to 5)	0.45	0.05	9.65	0.00
N. Non-commuting trips "11-20"	0.23	0.13	1.76	0.08
Mu(1)	1.49	0.06	24.36	0.00
Mu(2)	2.67	0.08	34.08	0.00
Mu(3)	3.73	0.11	33.00	0.00
McFadden Pseudo R-squared	.11			
N. Obs.	1207			

Stated willingness to use CS
- rating scale 1-5 -

Ordered logit	No 1	2	3	4	Yes 5
Age: 1 "18-25"; 2 "25-65"; 3 ">65" (ordinal)	0.16	-0.16	-0.08	-0.05	-0.03
City size: 20k-50k inhabitants (dummy)	0.27	-0.27	-0.22	-0.06	-0.04
Retired (dummy)	0.34	-0.11	-0.13	-0.10	-0.04
Unemployed (dummy)	-0.27	-0.21	0.06	0.18	0.25
N. Commuting trips: 0 "0"; 1 "1-10"; 2 "11-20"; 3 ">20"(ordinal)	-0.08	0.00	0.04	0.02	0.02
Environmental awareness (ordinal, 1 to 5)	-0.10	0.00	0.05	0.03	0.02
CS knowledge (ordinal , 1 to 5)	-0.10	0.00	0.05	0.03	0.02
n. viaggi tempo libero "11-20"	-0.05	0.00	0.02	0.02	0.01

- Willingness of using CS
  - decreases as:
    - age increases; city size is too small/large; status retired
  - increases as:
    - Status unemployed; n. commuting trips increases; environmental awareness and CS knowledge increases; large n. of non-commuting trips

Potential change of commuting mobility patterns

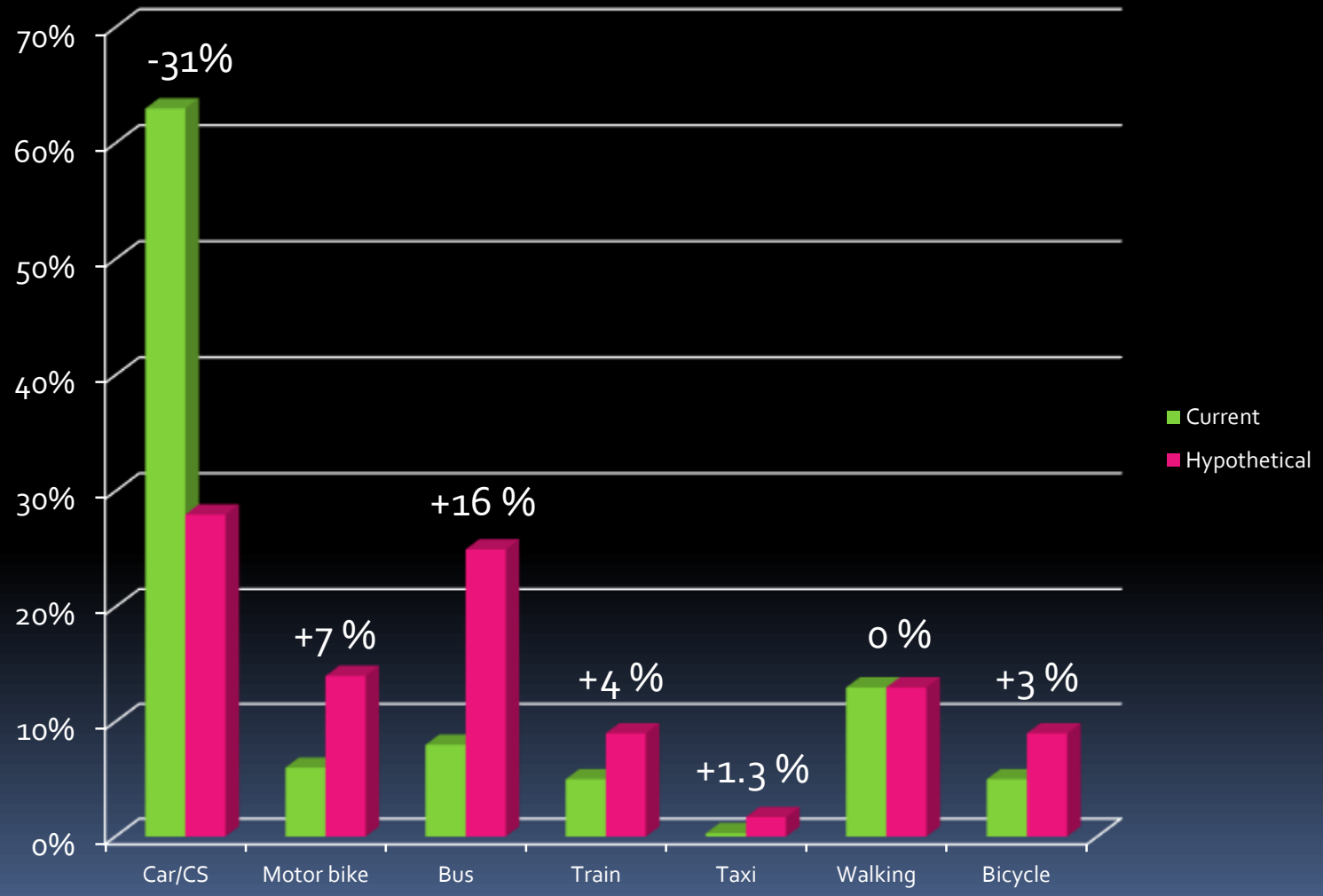


Socio-ec. determinants of potential demand for commuting

Logit willingness to use CS for at least 1 non commuting trip	Coeff.	Std.Err.	t-ratio	P-value
ONE	1.66	0.29	5.75	0.00
City size: 20k-50k inhabitants (dummy)	-0.77	0.20	-3.93	0.00
N. Commuting trips: 10-20 (dummy)	0.36	0.17	2.11	0.03
Commuting distance travelled: 1-25 (dummy)	-0.97	0.19	-5.08	0.00
CS knowledge (ordinal , 1 to 5)	0.12	0.06	2.04	0.04
Student (dummy)	0.40	0.16	2.47	0.01
N. Driver license (cardinal)	0.13	0.08	1.75	0.08
N. children < 18 age (cardinal)	0.20	0.10	2.02	0.04
McFadden Pseudo R-squared	.06			
N. Obs.	1125			

- Willingness of using CS for commuting trips
  - decreases as:
    - medium city size; distance travelled < 25 km
  - increases as:
    - n. commuting trips 10-20; CS knowledge; status student; n. of driver license; n. children < 18 age

Potential change of non-commuting mobility patterns



Socio-ec. determinants of potential demand for non-commuting

Logit willingness to use CS for at least 1 commuting trip	Coeff.	Std.Err.	t-ratio	P-value
ONE	2.70	0.47	5.70	0.00
Age 30-60 (dummy)	-0.59	0.20	-2.94	0.00
Age >60 (dummy)	-1.46	0.40	-3.62	0.00
City: TS (dummy)	0.10	0.07	1.54	0.12
Student (dummy)	0.60	0.37	1.63	0.10
Employed (dummy)	0.53	0.33	1.62	0.10
Environmental awareness (ordinal, 1 to 5)	0.21	0.06	3.33	0.00
N. non-commuting trips < 6 (dummy)	-0.29	0.15	-1.90	0.06
Distance travelled: 26-50 km (dummy)	0.67	0.20	3.29	0.00
Distance travelled: 51-100 km (dummy)	1.15	0.20	5.86	0.00
Distance travelled: 101-200 km (dummy)	1.19	0.21	5.62	0.00
Distance travelled > 200 km (dummy)	1.29	0.23	5.72	0.00
CS knowledge (ordinal , 1 to 5)	0.23	0.05	4.48	0.00
McFadden Pseudo R-squared	.12			
N. Obs.	1271			

Socio-ec. determinants of potential demand for non-commuting

- Willingness of using CS for non-commuting trips
  - decreases as:
    - age > 30; n. of trips too small (<6)
  - increases as:
    - city size large (TS); status: student or employed; environmental awareness and CS knowledge increases; distance travelled increases

Probability of using a CS

- Estimation of the annual generalized costs of the commuting and non-commuting trips at the individual level given:
  - the stated current mobility pattern
  - the stated hypothetical mobility pattern if the car is not available while the CS is available
  - the value of the monetary and non-monetary components of the generalized costs
- 10,000 simulation runs for each individual
- Comparison of the total mobility cost of scenario A (no CS) and B (no private auto)

$$\text{Probability of using CS by person n} = \frac{\sum_{i=1}^{10000} x_i^n}{10000} \quad for \begin{cases} x_i^n = 1 \;\; if \;\; GC^A > GC^B \\ x_i^n = 0 \;\; if \;\; GC^A > GC^B \end{cases}$$

Probability of using a CS

	Number of persons	%
Unwillingness to use CS both for commuting and non commuting trips	645	52
Probability less than 25%	307	24
Probability between 25% and 50%	250	20
Probability between 50% and 75%	51	4
Probability between 75% and 100%	23	2
Total	1276	100

Probability of using a CS in FVG

- From the sample to the population on the basis of city size and age

	Number of persons	%
Stated unwillingness to use CS	621,428	59.9
Probability less than 25%	198,742	19.2
Probability between 25% and 50%	171,979	16.6
Probability between 50% and 75%	36,709	3.5
Probability between 75% and 100%	8,311	0.8
Total	1,037,168	100

Socio-ec. determinants of probability of using CS

Ordered Logit 0 (no CS) – 4 (prob .CS [0.75-1])	Coeff.	Std.Err.	t-ratio	P-value
ONE	-1.55	0.28	-5.52	0.00
Age 30-60 (dummy)	-0.60	0.13	-4.76	0.00
Age >60 (dummy)	-2.02	0.32	-6.36	0.00
n. children	0.13	0.08	1.58	0.11
n. cars/driver license	0.74	0.21	3.52	0.00
City: TS (dummy)	0.26	0.12	2.20	0.03
Environmental awareness (ordinal, 1 to 5)	0.18	0.06	3.21	0.00
CS knowledge (ordinal , 1 to 5)	0.24	0.05	5.37	0.00
Mu(1)	1.19	0.06	20.03	0.00
Mu(2)	2.97	0.12	25.14	0.00
Mu(3)	4.20	0.21	20.03	0.00
McFadden Pseudo R-squared	.04			
N. Obs.	1175			

Socio-ec. determinants of probability of using CS

Ordered logit	No willingness of using CS	Estimated prob. Of using CS			
		0 – 0.25	0.25 – 0.5	0.5 – 0.75	0.75-1
Age 30-60 (dummy)	0.15	-0.04	-0.08	-0.02	-0.01
Age >60 (dummy)	0.42	-0.19	-0.18	-0.04	-0.02
n. children	-0.03	0.01	0.02	0.00	0.00
n. cars/driver license	-0.18	0.05	0.10	0.03	0.01
City: TS (dummy)	-0.06	0.01	0.04	0.01	0.00
Environmental awareness (ordinal, 1 to 5)	-0.04	0.01	0.02	0.01	0.00
CS knowledge (ordinal , 1 to 5)	-0.06	0.01	0.03	0.01	0.00

- Willingness of using CS
  - decreases as:
    - age increases
  - increases as:
    - n. of children and of cars increases; large city size; environmental awareness and CS knowledge increases;

Internal validation

Ordered Logit 0 (no CS) – 4 (prob .CS [0.75-1])	Coeff.	Std.Err.	t-ratio	P-value
ONE	-2.06	0.29	-7.07	0.00
Age 30-60 (dummy)	-0.36	0.13	-2.74	0.01
Age >60 (dummy)	-1.59	0.32	-4.93	0.00
n. children	0.12	0.08	1.43	0.15
n. cars/driver license	0.96	0.21	4.50	0.00
City: TS (dummy)	0.11	0.12	0.91	0.36
Environmental awareness (ordinal, 1 to 5)	0.05	0.06	0.78	0.43
CS knowledge (ordinal , 1 to 5)	0.17	0.05	3.56	0.00
Stated willingness to use CS	0.44	0.05	8.88	0.00
Mu(1)	1.26	0.06	20.24	0.00
Mu(2)	3.09	0.12	25.76	0.00
Mu(3)	4.33	0.21	20.55	0.00
McFadden Pseudo R-squared	.07			
N. Obs.	1175			

Internal validation

Ordered logit	No willingness of using CS	Estimated prob. Of using CS			
		0 – 0.25	0.25 – 0.5	0.5 – 0.75	0.75-1
Age 30-60 (dummy)	0.09	-0.03	-0.05	-0.01	0.00
Age >60 (dummy)	0.35	-0.16	-0.15	-0.03	-0.01
n. children	-0.03	0.01	0.02	0.00	0.00
n. cars/driver license	-0.24	0.07	0.13	0.03	0.01
City: TS (dummy)	-0.03	0.01	0.02	0.00	0.00
Environmental awareness (ordinal, 1 to 5)	-0.01	0.00	0.01	0.00	0.00
CS knowledge (ordinal , 1 to 5)	-0.04	0.01	0.02	0.01	0.00
Stated willingness to use CS	-0.11	0.03	0.06	0.01	0.01

- Willingness of using CS
  - decreases as:
    - age increases
  - increases as:
    - n. of children and of cars increases; large city size; environmental awareness and CS knowledge increases; Stated willingness using CS increases

Summary

	Rating CS use	CS Mobility Commuting	CS Mobility Non-commuting	Estimated probability CS use
Age	Neg.		Neg.	Neg.
Status	Retired Unemployed	Students	Students Employed	
N. Children		Pos.		Pos.
N. Driver license		Pos.		
N. Car/driver license				Pos.
Environmental awareness	Pos.		Pos.	Pos.
CS Knowledge	Pos.	Pos.	Pos.	Pos.
N. Trips	Pos.	10-20	Pos.	
Distance		>25km		
City size	Not Medium (20k-50k)	Not Medium (20k-50k)	Large	Large

Conclusions

- Significant potential demand for CS in FVG: 4.3 % of the population
- Most important socio-economic factors:
  - Age; Status; n. driver license or cars; n. children
  - CS Knowledge; Environmental awareness;
  - type and number of trips; distance travelled
  - city size
- Demand is affected by:
  - Characteristics of the supply:
    - fees; free floating/point-to-point/return; operating zone; N. and type of vehicles
  - Transport policies:
    - Parking; Limited Traffic Zone; Dedicated lanes; Fee payed by the operator to the Municipality
  - Availability of complementary transport services (public transport)
    - Positive network externalities
  - Number and spatial distribution of residential, commercial, productive and tertiary activities

Future research

- Validation of the model using real demand data
- Analysis of mobility patter change assuming that both car and CS are available
- Financial and economic sustainability of the service
  - Analyze the cost structure of existing operators
  - Simulate the profitability on the bases of
    - Service type
    - Vehicle type
    - Number of Vehicles
    - Transport policies
    - Number of customers
    - Distance travelled
    - Frequency

	unit	T(min, max, mean)
Private car		
Purchase cost	€	1000, 22000, 6100
N° of years before the market value goes to zero	n°	1, 10, 5
Road tax	€	80, 360, 181
Insurance cost	€	250, 800, 515
Monetary value of the risk of uninsured theft or damage	€	0, 2500, 747
Ordinary and extraordinary maintenance cost	€	100, 1000, 322
WTP for avoiding the nuisance of maintaining and refuelling your car	€	0, 600, 202
Opportunity cost of the private garage	€	0, 1200, 213
Weekly parking costs	€	0, 10, 2
Time spent to search for a parking place	min.	0, 15, 3
Monetary value of the pleasure of owning a car	€	0, 7000, 1742
WTA to give up the private car	€	100, 5000, 2267
Motorcycle		
Purchase cost	€	525, 1500, 1181
N° of years before the market value goes to zero	n°	2, 5, 4
Road tax	€	10, 35, 20
Insurance cost	€	56, 270, 174
Monetary value of the risk of uninsured theft or damage	€	0, 100, 56
Ordinary and extraordinary maintenance cost	€	50, 150, 95
WTP for avoiding the nuisance of maintaining and refuelling the motorcycle	€	0, 50, 24
Monetary value of the pleasure of owning a motorcycle	€	20, 750, 530
WTA to give up the motorcycle	€	400, 700, 550
Bicycle		
Purchase cost	€	10, 50, 37
N° of years before the market value goes to zero	n°	0, 2, 1
Monetary value of the pleasure of owning a bicycle	€	0, 10, 5
Monetary value of the nuisance of cycling	€	0, 0, 0
Walking		
Monetary value of the pleasure of walking	€	10, 500, 209
Monetary value of the nuisance of walking	€	0, 100, 49
Carsharing		
Membership fee	€	20, 100, 50
Minutes needed to reach a CS car	n°	5, 10, 8
WTP for avoiding the nuisance of having to book a CS car	€	20, 100, 61
WTP for avoiding the risk of founding no CS car available when you need it	€	30, 300, 111
Monetary value of the satisfaction of being a CS user	€	0, 300, 114