E-carsharing: a methodology to assess the market potential

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Project: Eletric Car Sharing

Funded by the Friuli Venezia Giulia Region, Italy

Sustainable mobility: 90% fuel subsidies

Project: Eletric Car Sharing

Product innovations, private firms involvement, zero-emission passenger vehicles

Innovations:

- Station E-cars (E-way Milan)
- E-car fleet management (Guidami Milan)
- E-carsharing (Car2go S. Diego, Autolib Paris)

Research, software, experimentation

Questions and doubt

- Will our innovations work in the FVG region?
- How could they properly be implemented?
- How many people or firms will be using them?
- Will the revenues cover the costs?

Carsharing: definition

Carsharing is a model of car rental where people rent cars for short periods of time, often by the hour.

Cars are managed by an organization, such as commercial business, a public agency, a cooperative, or ad hoc grouping.

Niche market with impressive growth rates

Tabella (1): Utenza e veicoli car sharing nel mondo, anno 2006.

	EUROPA	NORDAMERICA	ASIA	AUSTRALIA	TOTALE
UTENZA	213.424	117.656	15.700	1.130	347.910
VEICOLI	7.686	3.337	608	65	11.696

- North America - July 2008: 33 operators, 318,838 members, 7,505 vehicles
- Switzerland - Mobility 2012 - 2,600 vehicles , 1,300 locations.
- Italy, ICS , 2011, 599 vehicles, 404 parking places, 17,925 member, located in 12 Italian cities.

Literature on:

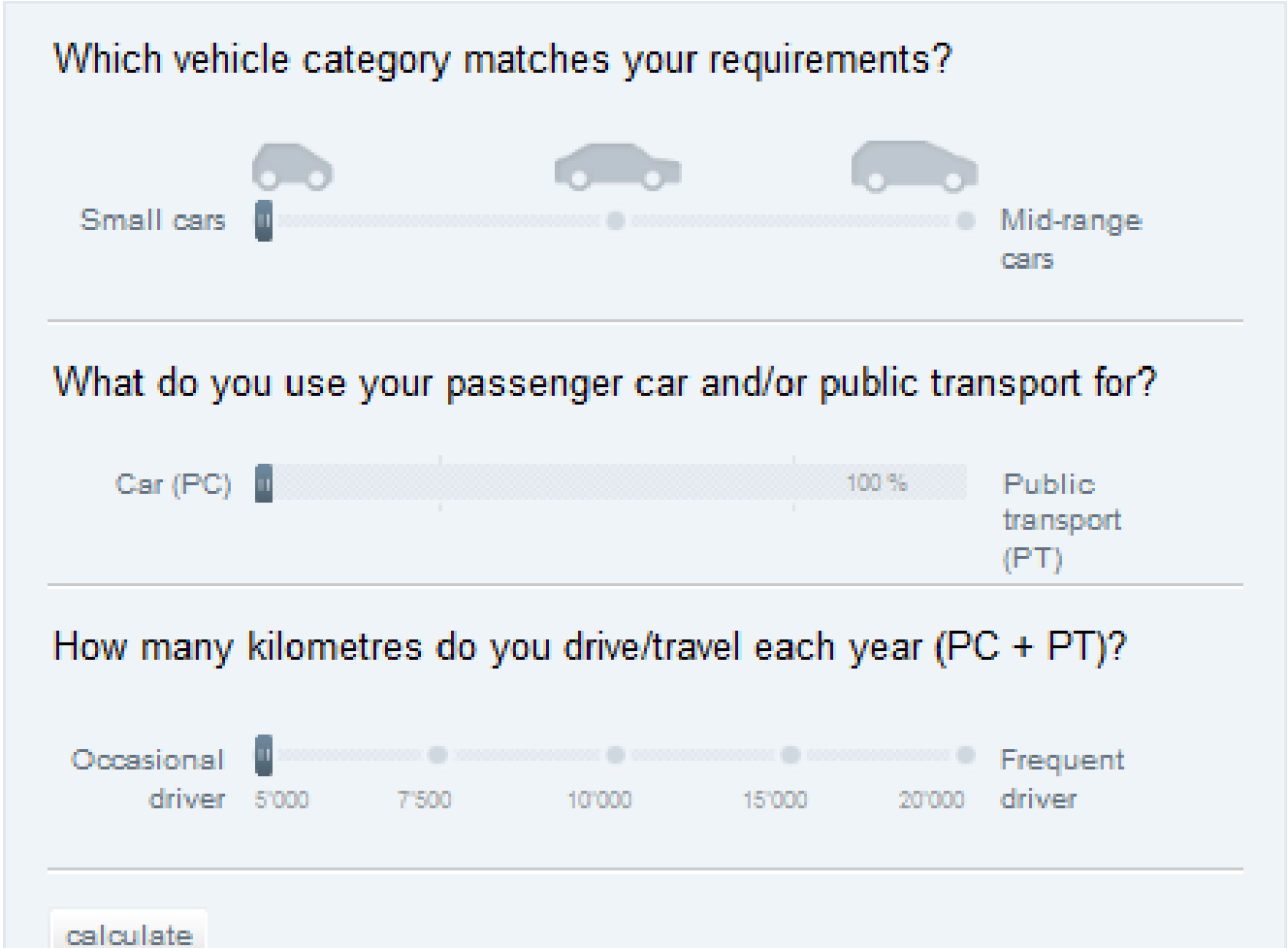
- The growth and expansion of carsharing
- Administrative or logistical aspects of running a carsharing organization
- The actual usage of the carsharing vehicles, the people who have chosen to join a carsharing service
- How the adoption of carsharing impacts vehicle kilometers travelled and vehicle ownership
- The familiarity with the concept of carsharing and willingness to accept it

What is the actual market potential of carsharing?

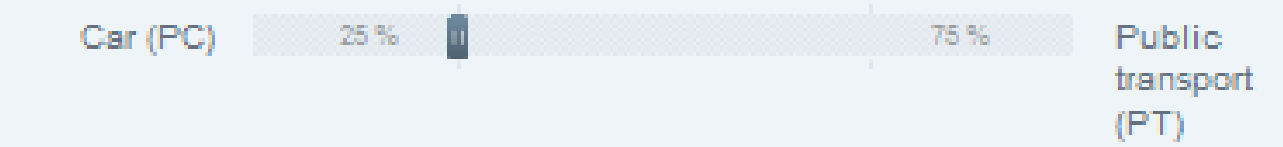
1. Schuster et al. (2005): a simulation model
2. Catalano et al. (2008): discrete choice model
3. Ciari et al (2009, 2010): an agent based traffic micro-simulation tool
4. Ducan (2011): detailed calculations with further restrictions

Carsharing operating companies: cost comparison tool (Mobility, CH)

- Focus on auto type and kilometers driven



What do you use your passenger car and/or public transport for?



How many kilometres do you drive/travel each year (PC + PT)?

calculate

With your selection, you will save:

CHF 3632.-

in combination with public transport (75%) and CarSharing (25%)

Previous costs for your mobility	7432.-

Schuster, T., Byrne, J., Corbett, J., Schreuder, Y.: Assessing the potential extent of carsharing: a new method and its implication. Transp. Res. Rec. 1927, 174–181 (2005)

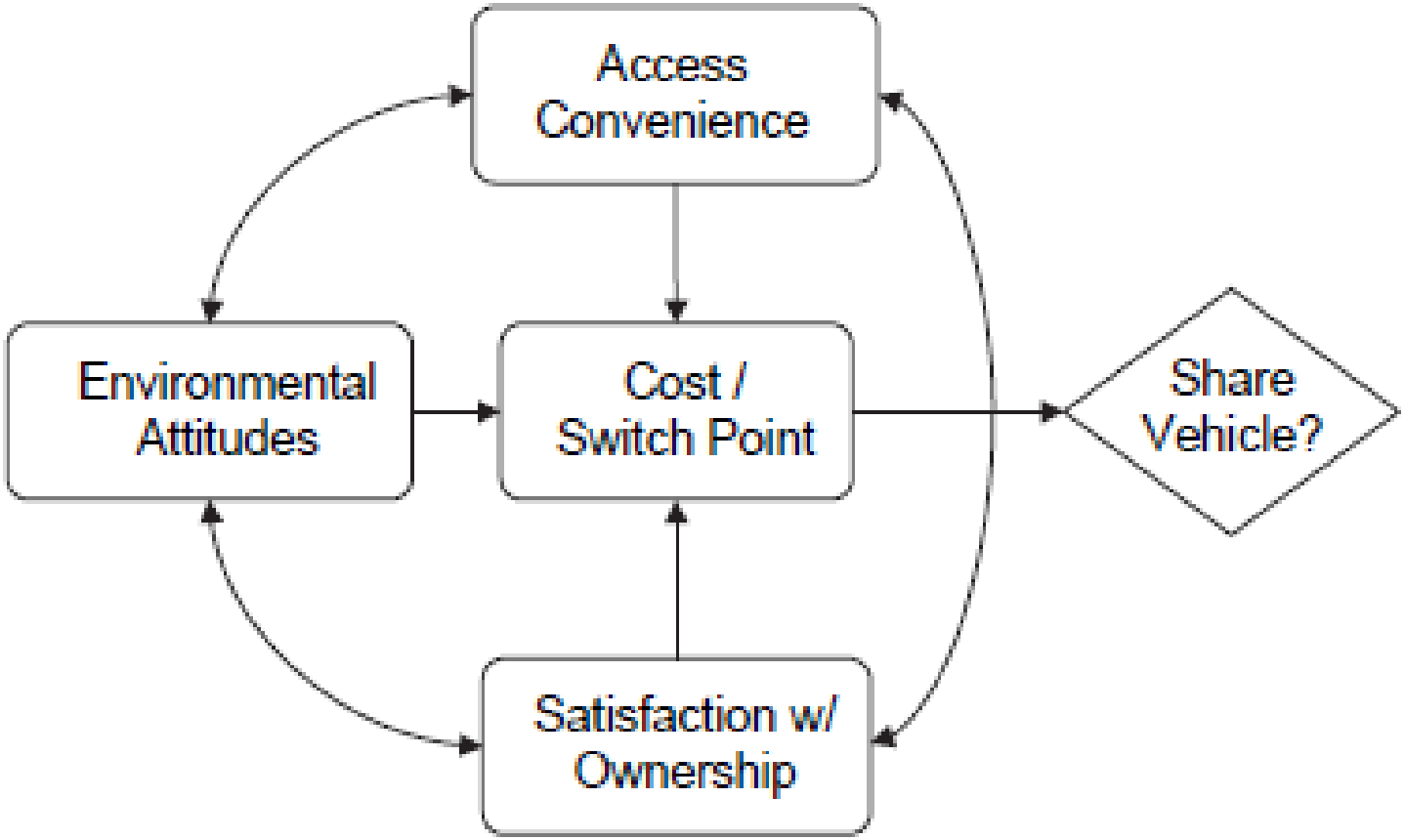


FIGURE 1 Conceptual model of carsharing versus ownership decision. Attitudinal factors affect the cost switch point, which is the monetary value on which the decision is based.

Assumptions

- Attidudinal factors are not considered
- Focus on vehicles instead of individuals
- Focus on monetary costs

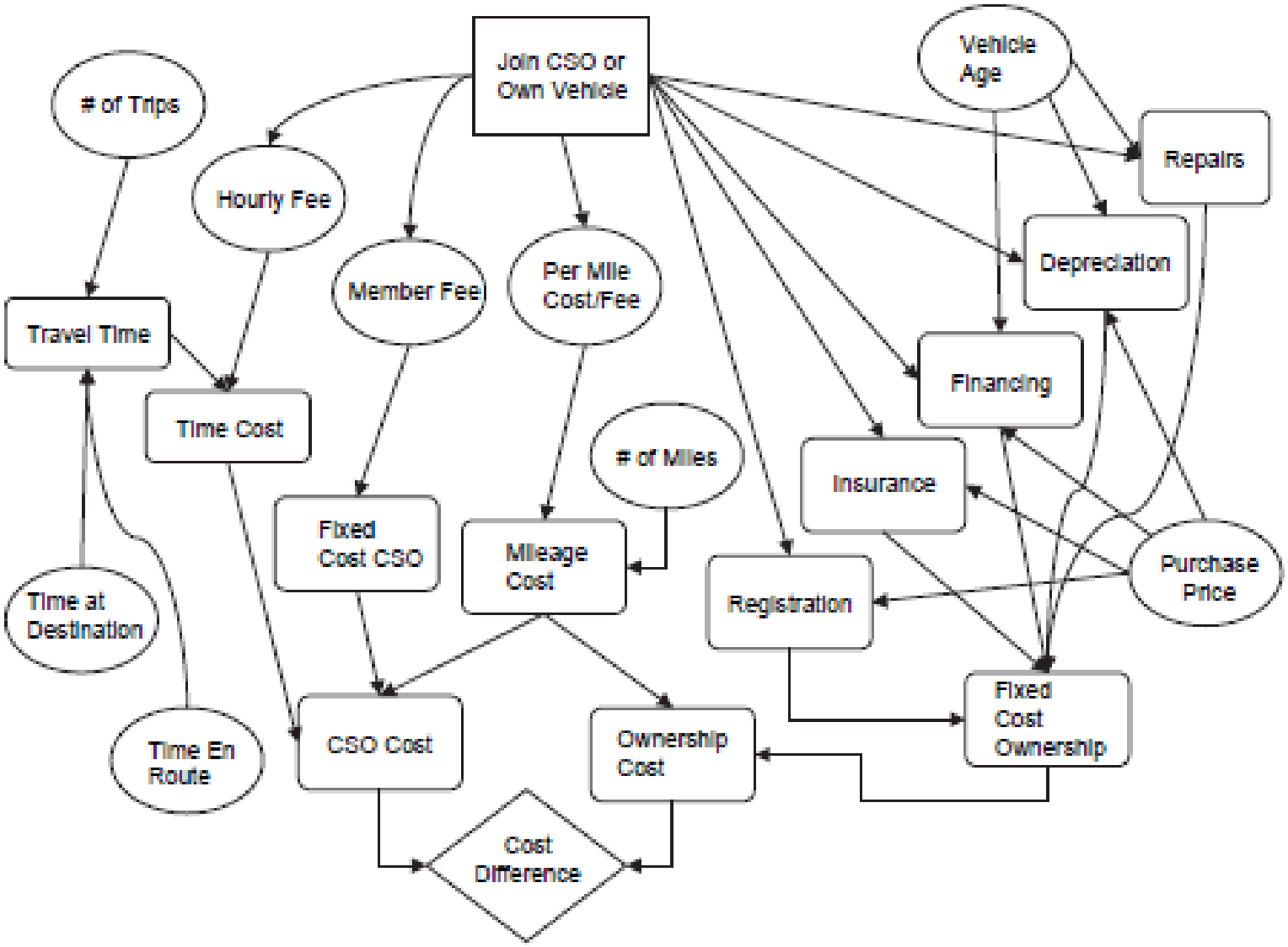


FIGURE 2 Influence diagram of the economic decision to own or share. This is an expansion of the center (cost) component of Figure 1. All nodes are explicitly considered in the simulation, and arrows represent relationships modeled either through equations or correlations.

CSO costs in Baltimore

- the Flexcar program in the nearby Washington, D.C., metropolitan area in March 2004
- The annual membership fee is $25, the hourly rate is $9, and the mileage fee is $0.35.

Travel behaviour

- The NHTS included a 1-day trip diary, with information on these variables, as well as trip distance, purpose, and vehicle used (24,000 trips taken in 4,515 vehicles).
- Daily travel time was multiplied by 365 to get annual travel time, assuming a representative travel day.

Results for Baltimore

- In the base case, carsharing was chosen 1,474 out of 35,500 trials, or 4.15 ± 0.10% of the time.
- Expensive Vehicles and Prestige Value: 3.69 ± 0.09%,
- Commuter-Based Operational Model: 14.77 ± 0.37%
- Comparable to the area transit mode share, which is 5.7%
- Preliminary evidence suggests that carsharing may prove a useful part of an integrated strategy to reduce the negative effects of auto dependence.

Limitations

- Travel patterns with limited details
- Non-monetary factors
- Socio-economic characteristics
- Etc ……

Catalano, M., Lo Casto, B., Migliore M. (2008) - Car sharing demand estimation and urban transport demand modelling using stated preference techniques, European Transport \ Trasporti Europei n. 40: 33-50

Discrete choice model

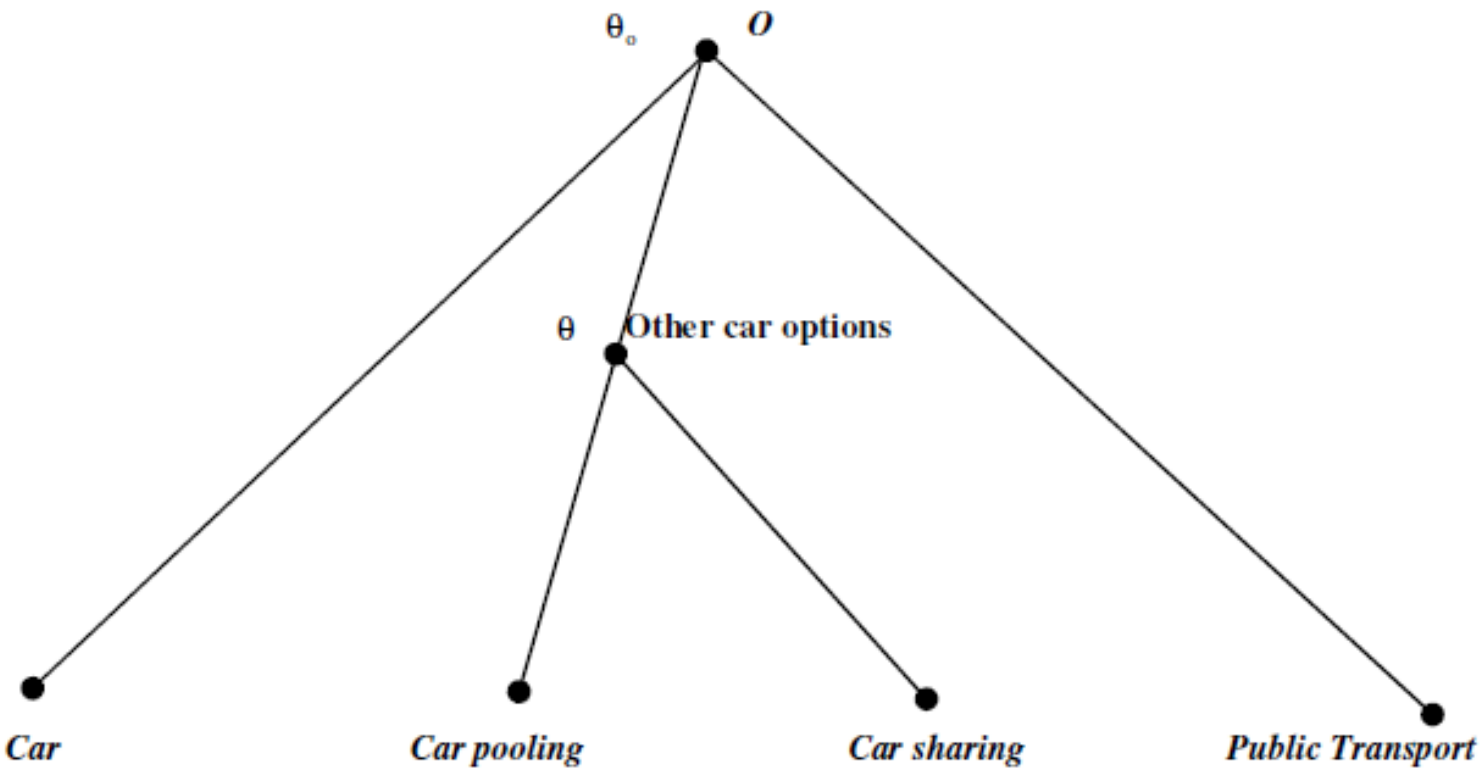
$$V_{CAR} = \beta_{T_{TRAVEL}} \cdot T_{TRAVEL} + \beta_{C_{TRAVEL}} \cdot C_{TRAVEL} + \beta_{T_{PARKING}} \cdot T_{PARKING} + \beta_{CAR} \cdot CAR$$

$$V_{CARPOOLING} = \beta_{T_{TRAVEL}} \cdot T_{TRAVEL} + \beta_{C_{TRAVEL}} \cdot C_{TRAVEL} + \beta_{T_{PARKING}} \cdot T_{PARKING}$$

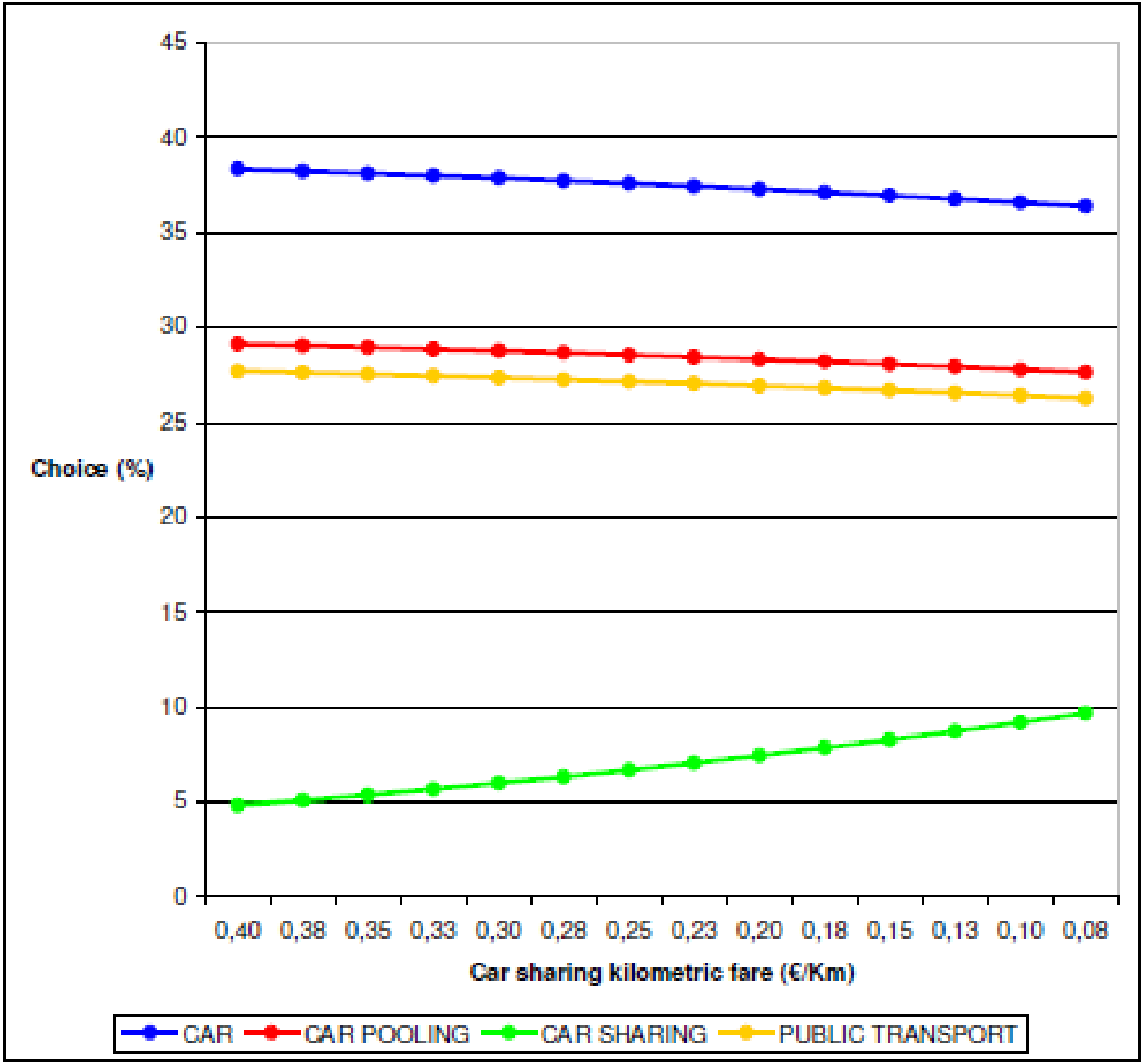
$$V_{CARSHARING} = \beta_{T_{TRAVEL}} \cdot T_{TRAVEL} + \beta_{C_{TRAVEL}} \cdot C_{TRAVEL} + \beta_{T_{PARKING}} \cdot T_{PARKING} + \beta_{NCARS} \cdot NCARS + \beta_{CS} \cdot CS$$

$$V_{PUBLICTRANSPORT} = \beta_{T_{TRAVEL}} \cdot T_{TRAVEL} + \beta_{C_{TRAVEL}} \cdot C_{TRAVEL} + \beta_{PT} \cdot PT$$

Nested logit model



Simulation for Palermo



Ciari, F., (2010) Estimation of Car-Sharing Demand Using an Activity-Based Microsimulation Approach: Model Discussion and Preliminary Results, Conference paper Swiss Transport Research Conference (STRC) 2010.

- Estimated with MATSim

Duncan, M. (2011) “ The cost saving potential of carsharing in a US context”, Transportation, 38: 363–382

Research questions

- What kind of vehicle usage patterns can carsharing accommodate in a cost effective manner?
- And how many vehicles in the Bay Area have driving patterns that meet the threshold at which carsharing becomes less expensive than auto ownership?

Travel diaries

- The 2000 Bay Area Travel Survey (BATS) is used to address this question. The BATS includes a sample of more than 15,000 households that were asked to keep a 2-day activity diary for each household member.
- The diary entries can be used to track the time, place, and mode for each individual's travel movements. In the case of private auto trips, the specific vehicle used for a trip was recorded and this allows for a detailed accounting of the usage pattern for each vehicle owned by a BATS household (roughly 28,000 vehicles in total).

Tariff structure

Table 1 Pricing plans offered by Bay Area carsharing companies

	Annual fee	Minimum per month	Distance charges	Time charges		
				Weekday	Weekend	"Night Owl" (12 a.m.–8 a.m.)
City CarShare						
Plan 1	$45	n/a	$0.25/km	$6.50/h	$7.50/h	n/a
Plan 2	$120		$0.22/km	$5.50/h	$6.00/h	$1.50/h
Plan 3	$240		$0.22/km	$5.50/h	$6.00/h	No charge
Zipcar						
Plan 1	$50	n/a	First 290 km/day: no charge Additional km: $0.28/km	$7.00/h or $73.00/day	$7.00/h or $88.00/day	n/a
Plan 2	n/a	$50		$6.30/h or $65.70/day	$6.30/h or $79.20 day	
Plan 3	n/a	$250		$5.95/h or $62.05/day	$5.95/h or $74.80/day	

The distance charges listed for Zipcar apply to all three zip car plans

Carsharing costs

- Scenarios on the number of carsharing pods (current 175, 375 pods, ubiquitous access)
- Estimation of pod access costs
- Additional costs and benefits
  - Inconvenience associated with always having to reserve a vehicle in advance
  - No guarantee that a vehicle will be available at the time it is most needed.
  - LImited ability to choose a vehicle that most closely matches its needs and preferences.
  - Not having to worry about keeping a vehicle properly maintained and registered.
- Factors not considered for lack of good data

Two dimensions of driving behavior

- Carsharing for commuting
- Carsharing for non-work travel

Table 5 Percentage of vehicles/households for which carsharing has a lower cost than vehicle ownership

Pod location assumption	Vehicle ownership assumption	% of vehicles where carsharing cost is		% of households owning at least 1 vehicle where carsharing cost is	
		Less than ownership cost (%)	Less than ownership cost by at least $100 per month (%)	Less than ownership cost (%)	Less than ownership cost by at least $100 per month (%)
Current locations (scenario 1)	Low cost (used subcompact)	3.7	0.9	5.4	1.1
	Carsharing-equivalent (new compact)	6.5	4.9	9.3	7.1
Expanded locations (scenario 2)	Low cost (used subcompact)	9.0	1.2	13.0	1.5
	Carsharing-equivalent (new compact)	15.6	12.5	21.5	17.6
Ubiquitous (scenario 3)	Low cost (used subcompact)	23.5	3.3	31.2	4.6
	Carsharing-equivalent (new compact)	29.9	26.2	37.5	34.0

Non-monetary considerations

- The vehicle belongs to a household that owns no more than one vehicle per driver
- The vehicle belongs to a household with more than one car
- The vehicle belongs to a household with children under 6 years old
- The vehicle was manufactured before 1970
- The vehicle is a light truck (e.g., pickup truck, van, or SUV).

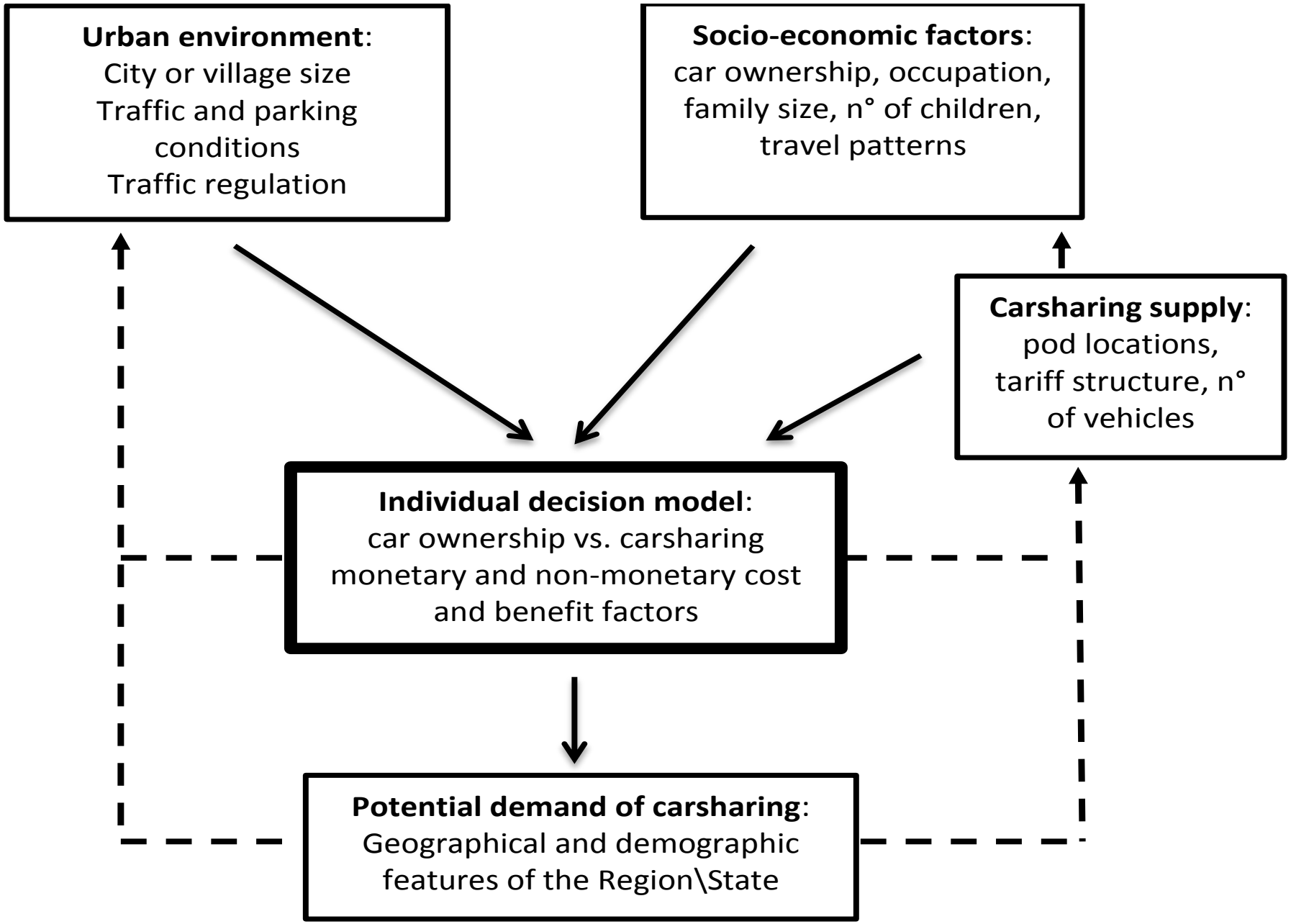
Duncan's conclusions

- A third of Bay Area households (more than 800,000) have at least one vehicle with a usage pattern that is economical conducive to carsharing.
- This combines with the quarter million Bay Area households that do not own a vehicle (as of the 2000 census) to make an impressive base of potential carsharing adopters.
- To put this in context, actual number of carsharing members across the entire US as of 2009 was less than 300,000.
- How well the cost saving potential of carsharing translates to more auto-oriented regions goes beyond the scope of this analysis but this certainly requires more attention.

Research question

- How could the discrepancy between the estimated market potential and the current market penetration be explained?

Our first preliminary methodology



Costs and benefits at individual level

- Net cost of owning a car = Vehicle depreciation + Car insurance + Risk of car theft and damages + Fuel cost + Vehicle registration fees + Parking cost during non-use + Park searching time + Transaction costs - Pleasure to have one's own private car - Status symbol quality of one's own car
- Net cost of carsharing = Use cost + Transaction costs + Risk of not finding a car for share when needed + Time to reach the pod - No nuisance for vehicle maintenance and parking - Ideological satisfaction

Net cost of owning a car

Type of settlement	Town	Town	Town	Town	Town	Town	Town	Town	Village	Village
Location	Centre	Centre	Centre	Centre	Periph.	Periph.	Periph.	Periph.		
User's occupation	Active	Active	Retired	Retired	Active	Active	Retired	Retired	Active	Retired
Car ownership	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Average simulated net cost of owning a car	2,545	3,045	2,020	2,520	1,945	2,445	1,770	2,270	1,645	2,145
Opportunity cost of car ownership*	2,113	2,113	2,113	2,113	2,113	2,113	2,113	2,113	2,113	2,113
Car insurance cost**	450	450	450	450	450	450	450	450	450	450
Risk of car theft and damages	100	100	100	100	100	100	100	100	50	50
Vehicle registration fees***	200	200	200	200	200	200	200	200	200	200
Vehicle excise duty	200	200	200	200	200	200	200	200	200	200
Parking searching cost	910	910	407	407	303	303	136	136	-	-
- Parking seraching time per trip (min.)	15	15	15	15	5	5	5	5	0	0
- N° of parking searches per year	243	243	109	109	243	243	109	109	243	109
- Monetary value of parking searching time (per min.)	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25
Transaction costs (maintance, refuelling)	10	10	10	10	10	10	10	10	10	10
Pleasure to have one's own private car	200	200	200	200	200	200	200	200	200	200
Status symbol quality of one's own car	100	100	100	100	100	100	100	100	100	100
Psychological cost of	500	-	500	-	500	-	500	-	500	-

Net cost of carsharing

Type of settlement	Town	Town	Town	Town	Town	Town	Town	Town	Village	Village
Location	Centre	Centre	Centre	Centre	Periph.	Periph.	Periph.	Periph.		
User's occupation	Active	Active	Retired	Retired	Active	Active	Retired	Retired	Active	Retired
Car ownership	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Average simulated cost of carsharing	13,070	13,070	2,030	2,030	13,270	13,270	2,113	2,113	14,678	2,547
Carsharing payments to the CS operator	12,371	12,371	1,970	1,970	12,371	12,371	1,970	1,970	14,482	2,621
- Annual membership cost	180	180	180	180	180	180	180	180	180	180
- Charging for CS time	11,136	11,136	1,465	1,465	11,136	11,136	1,465	1,465	11,136	1,465
- Charging for the distance travelled	1,055	1,055	326	326	1,055	1,055	326	326	3,166	977
Transaction costs (booking, paying)	50	50	20	20	50	50	20	20	20	20
Risk of not finding a car for share when needed	300	300	50	50	300	300	50	50	50	50
Cost of the time to reach the shared car pod	607	607	271	271	809	809	362	362	404	181
- Time spent to reach the CS pod	15	15	15	15	20	20	20	20	10	10
- Monetary cost of the time to reach the CS pod (per minute)	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
No nuisance for vehicle maintenance	20	20	20	20	20	20	20	20	20	20
Ideological satisfaction	100	100	100	100	100	100	100	100	100	100

Travel patterns

Type of settlement	Town	Town	Town	Town	Town	Town	Town	Town	Village	Village
Location	Centre	Centre	Centre	Centre	Periph.	Periph.	Periph.	Periph.		
User's occupation	Active	Active	Retired	Retired	Active	Active	Retired	Retired	Active	Retired
Car ownership	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
- simulated N° of trips per year*	243	243	109	109	243	243	109	109	243	109
- average N° of trips per year	240	240	100	100	240	240	100	100	240	100
- distance travelled per trip	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	45.0	45.0
- charge for km travelled	0.29	0.29	0.20	0.20	0.29	0.29	0.20	0.20	0.29	0.20
- average tour duration per trip in vehicle (hours)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
- average dwell time (hours)	8	8	2	2	8	8	2	2	8	2
- total duration of a trip (in hours)	8.5	8.5	2.5	2.5	8.5	8.5	2.5	2.5	8.5	2.5
- Charge for time per hour	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4

Net benefit of carsharing vs. car ownership and % of carsharing per segment

Type of settlement	Town	Town	Town	Town	Town	Town	Town	Town	Village	Village
Location	Centre	Centre	Centre	Centre	Periph.	Periph.	Periph.	Periph.		
User's occupation	Active	Active	Retired	Retired	Active	Active	Retired	Retired	Active	Retired
Car ownership	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Net benefit of carsharing vs car ownership	-10,006	-9,506	507	1,007	-10,815	-10,315	145	645	-12,545	40
% of carsahring	0.00%	0.00%	48.00%	90.90%	0.00%	0.00%	19.60%	64.70%	0.00%	18.30%

Lessons learned

Crucial factors

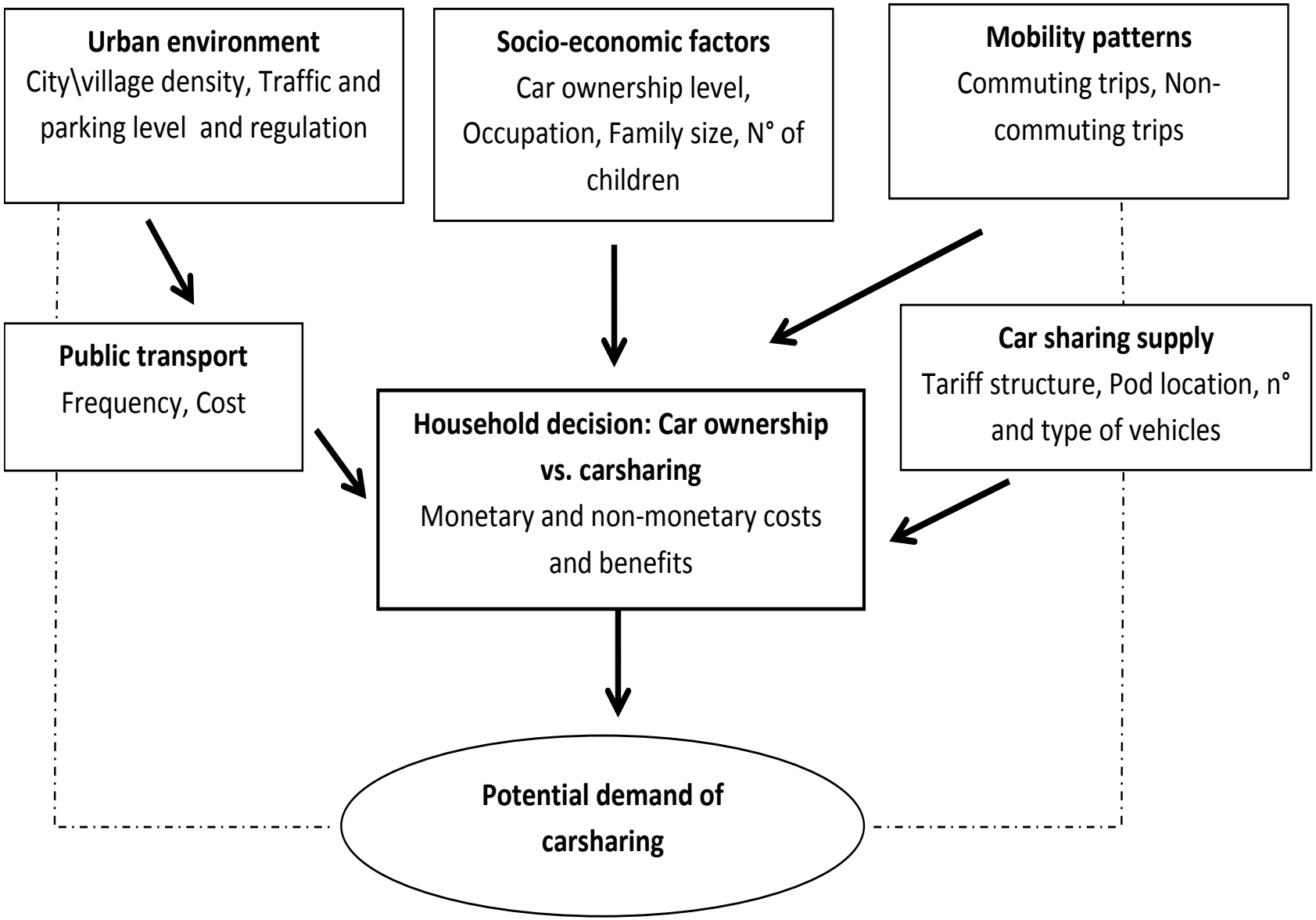
Data requirements

- Travel patterns
- Car ownership data
- Definition of the geographical areas
- Carsharing tariffs and localization of CS pod
- Socio-economic variable (licenses per household, number of children)

Montecarlo simulations for the monetary and quantitative variable. Assumptions on the distribution or fitting the distribution with historical data

Estimation of the monetary value for the non-monetary variables

Our second preliminary methodology



Thank you for your attention!