



TRANSPORT MODE CHOICE AND COMMUTING TO UNIVERSITY: A MULTINOMIAL APPROACH

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OUTLINE

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BACKGROUND

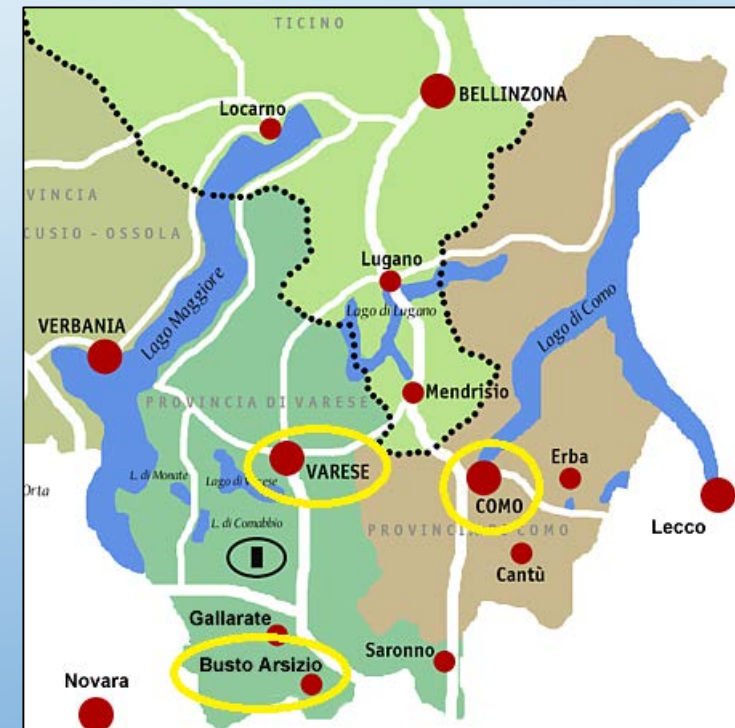
- As well as hospitals, courts and public bodies, universities are distinctive elements of a territory, economically significant and occupational poles but also generators and attractors of traffic (Rodriguez and Joo, 2004; Lovejoy and Handy, 2011; Delmelle and Delmelle, 2012).
- Commuting to school (including university) is a typical car-dominant scenario where effective (or perceived) alternative means are not available to users
- Dichotomy between travel polycultures and monocultures (Millera, 2011; Lavery et al., 2013)
- Sustainable commuting policies → to stimulate collective modal alternatives with a low environmental impact (Zhou, 2012)

RESEARCH CONTEXT

UNINSUBRIA IN A NUTSHELL

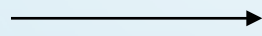
- The University of Insubria (Uninsubria) is an Italian state university founded in 1998.
- It is placed in the North-Western part of Italy and it has two main poles, Varese and Como, which attract a growing number of students. The third minor site is in Busto Arsizio (Varese).

| Role | Busto A. | Como | Varese | Total |
|------------|----------|------|--------|-------|
| Student | 59 | 2661 | 7787 | 10507 |
| T.A. Staff | 6 | 91 | 223 | 320 |
| Professors | 12 | 264 | 217 | 493 |
| Total | 77 | 3016 | 8227 | 11320 |



RESEARCH QUESTIONS

RQ1: Does the alleged car-dominance in commuting habits apply for Uninsubria poles?



Descriptive statistics

RQ2: What are the main drivers of modal choice to/from Uninsubria?



Econometric analysis (MNL)

RQ3: From a policy perspective, how commuters who travel to different poles (Varese, Como) give value to alternative more environmental friendly modes?



Pairwise t-tests

UNIVERSITY COMMUTING HABITS: SELECTED REVIEW

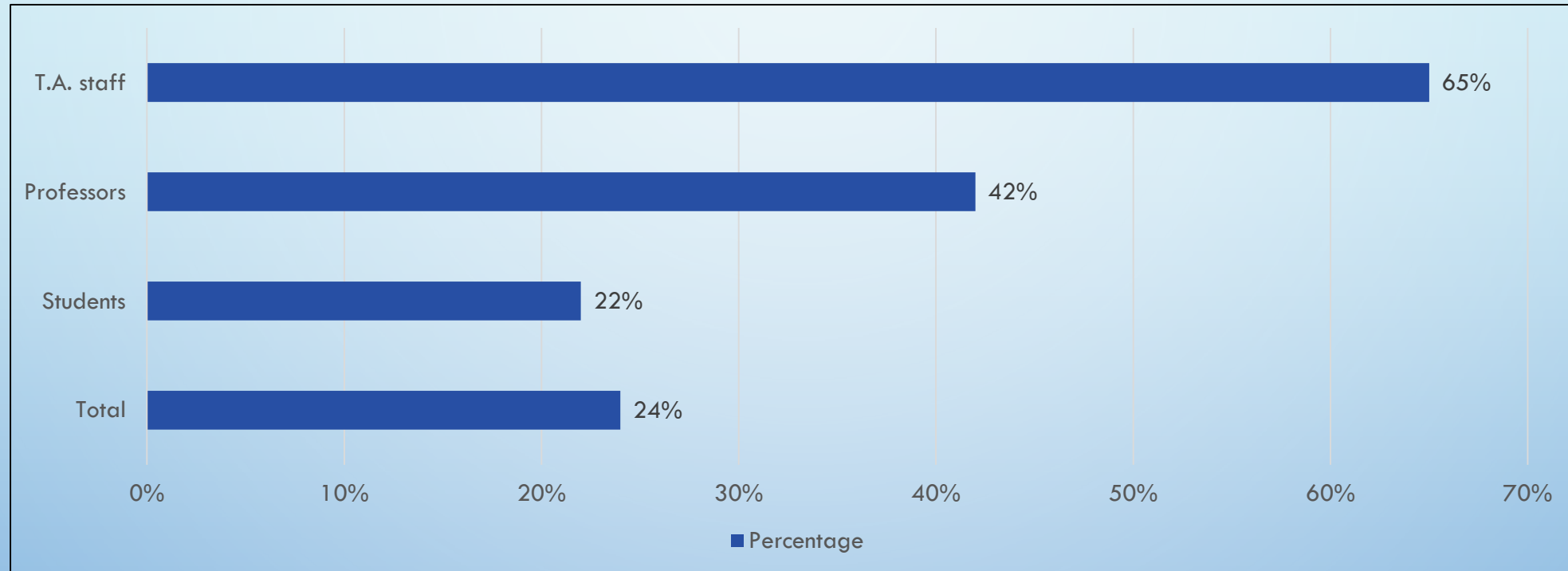
| Authors | Methods | Results |
|------------------------|---|--|
| Zhou (2012) | This paper studies university students (UCLA, Los Angeles, 2010 data) in the commuting and housing process in a predominant car context. | <ul style="list-style-type: none"> Discounted transit pass increase the odds of alternative modes. Parking permits reduce them. Commute distance is positively related to car-pooling. Gender and age are correlated to public transit. Having classmates living nearby increases the odds of taking public transit. |
| Whalen et al. (2013) | The report, based on a survey of the McMaster University, in Hamilton, Canada, tries to underline the mode choice and the factor that can influence it. | Two model used (MNL and nested Logit) to identify that modal choices are influenced by a mixture of cost, individual attitudes, and environmental factors. |
| Danielis et al. (2016) | Estimation of the potential demand for CS using simulation model starting using different models to estimate the demands of car sharing (not only focused on students). | Transportation sector is useful to satisfy the commuter's needs and behavior in relation with psychological cost\benefit elements |
| Lavery et al. (2013) | 4,154 university users (Canada). Ordered probit (number of feasible alternatives) | Active travellers: higher modality wrt to users of motorized modes. Density reduces the modality of users of local transit (buses). |

METHODOLOGY

UNINSUBRIA MOBILITY SURVEY

- On-line survey (november 2017): all the university users (students, professors, technical/administrative staff) for each site (Varese, Como and Busto Arsizio)
- Structure of the questionnaire:
 - Socio-demographic data (age, gender, education, role, residence)
 - Commuting-related data (distance, frequency, costs, destination, number of means used)
 - Information related to car pooling/sharing attitude, bike sharing and green sustainability attitudes
 - Evaluation of existing/prospective policy measures (e.g., shuttle bus)

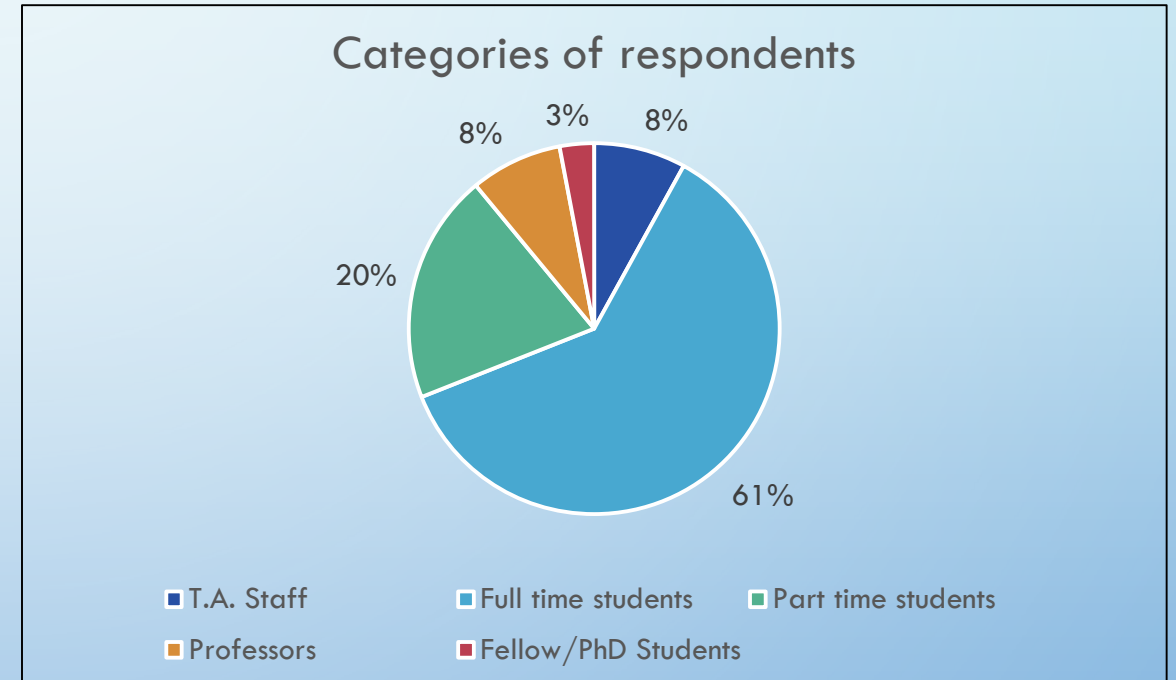
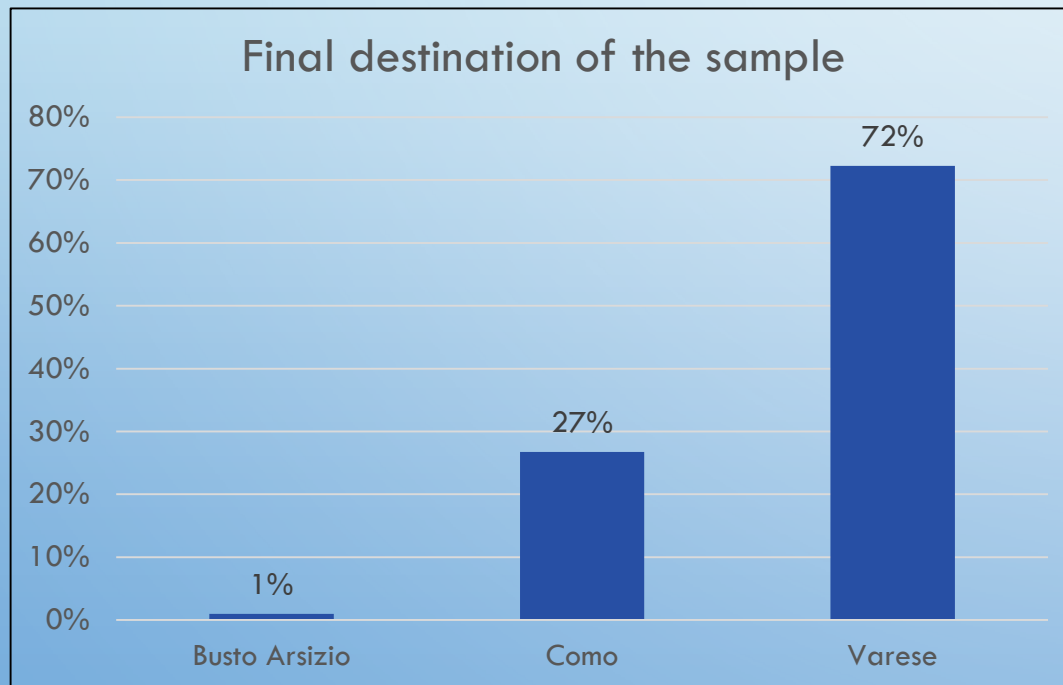
UNINSUBRIA MOBILITY SURVEY SAMPLE



- ▶ Out of 11,666 potential respondents, 2,816 interviews were gathered (about 24%)
- ▶ 2,795 valid data processing (adjustments due to misleading responses)

UNINSUBRIA MOBILITY SURVEY: PRIMARY DATA

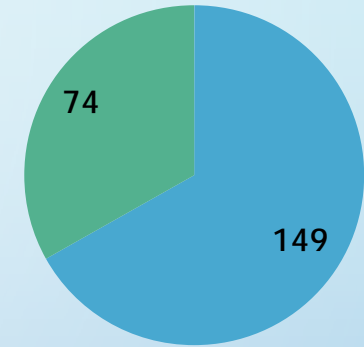
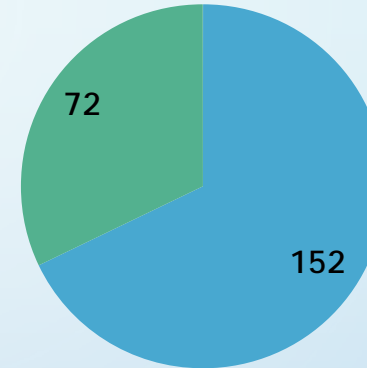
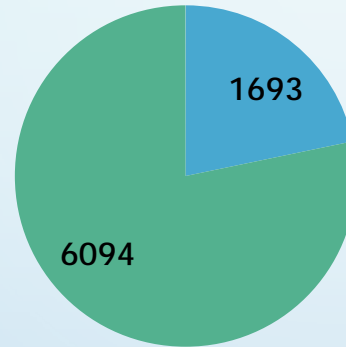
| Sample by category and destination | | | |
|------------------------------------|----------|------------|-------------|
| City | Students | Professors | T. A. Staff |
| Varese | 21% | 62% | 67% |
| Como | 23% | 15% | 64% |
| Busto Arsizio | 17% | 68% | 67% |



- ▶ Due to little information we have excluded from the econometric analysis the observations on Busto Arsizio (only descriptive statistics).

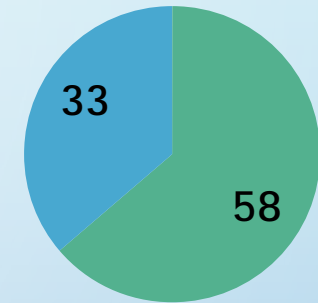
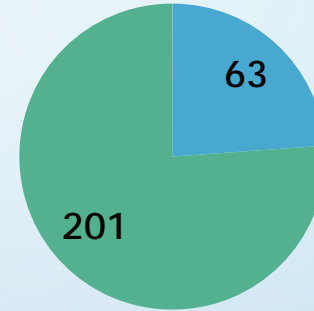
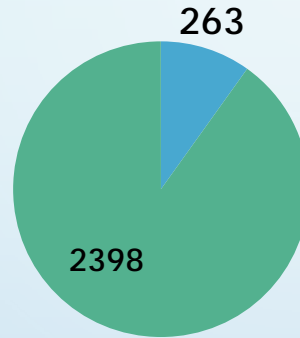
Sample Characteristics

VARESE



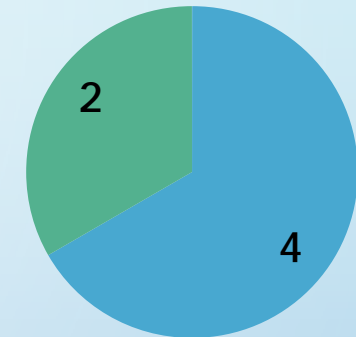
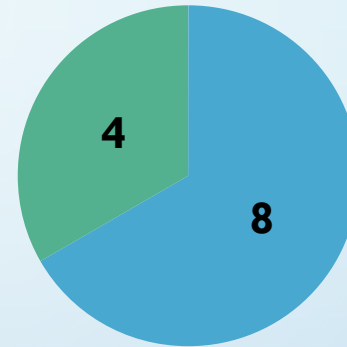
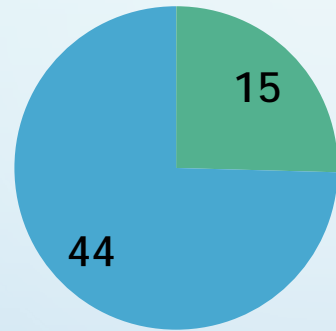
| | Students | Professors | T.A. Staff |
|--|-----------------------|-----------------------|--------------------------|
| Age | 23,76 | 51,5 | 47,09 |
| Gender | M (58%) | F (56.29%) | M (74%) |
| Day per Week | 3,9 | 3,6 | 4,7 |
| Principal Means of T. | Car/Motorbike(63.36%) | Car/Motorbike(76.82%) | Car/Motorbike(78.38%) |
| Number of Means | 1,55 | 1,32 | 1,12 |
| Duration of the Trip(min.) | 46 | 46 | 32 |
| Distance | 28 km | 40 km | 17 km |
| Monthly cost for transport | € 68 | € 78,45 | € 64,36 |
| Incidence of transport costs on Income(%) | No Income(57.8%) | Less than 5% (46.3%) | Between 5% and 10% (35%) |

Sample Characteristics COMO



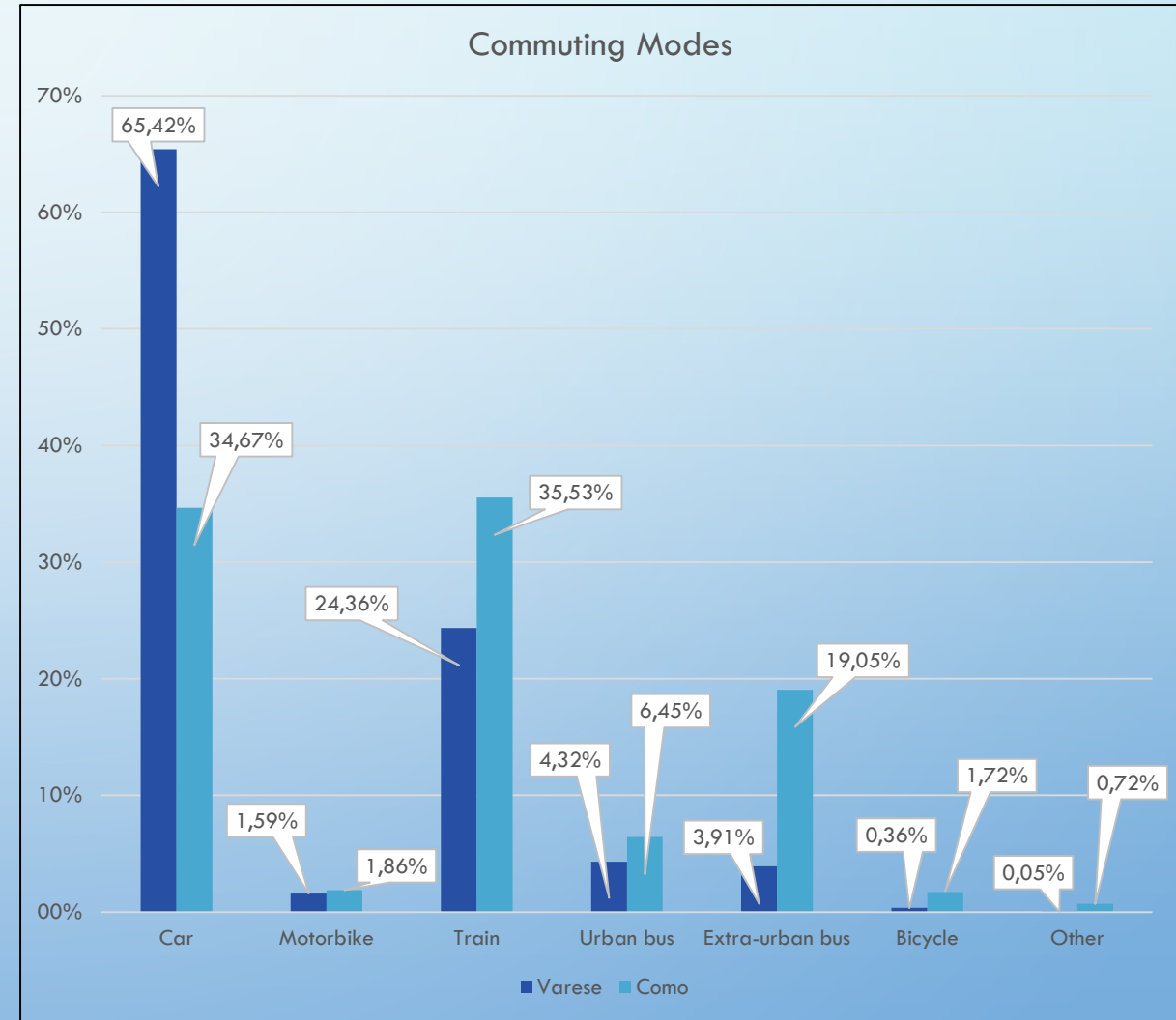
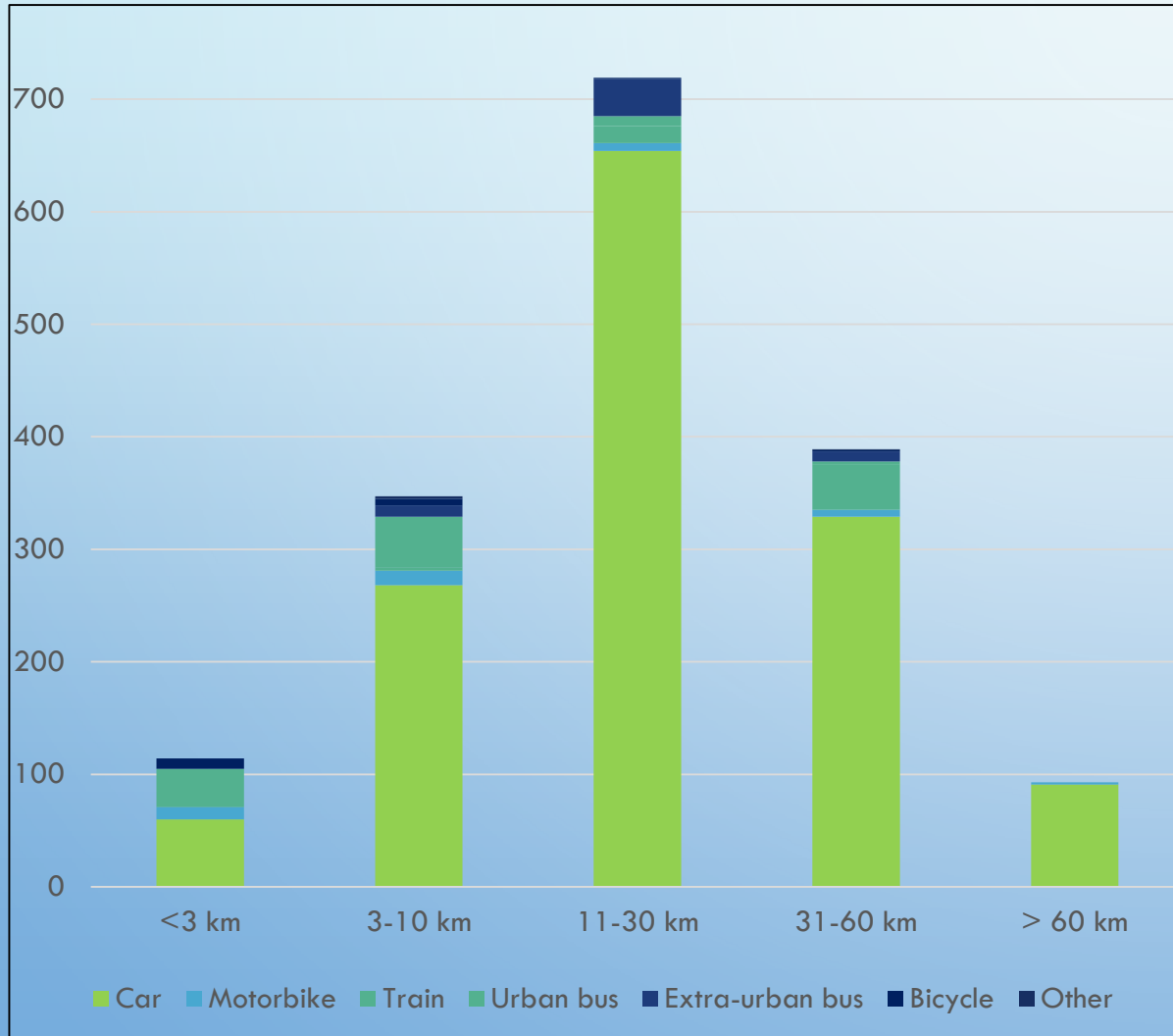
| | Students | Professors | T.A. Staff |
|--|-------------------|----------------------|----------------------|
| Age | 23,49 | 50 | 45,63 |
| Gender | M (69%) | F (60.32%) | M (62%) |
| Day per Week | 4.1 | 3.5 | 4.98 |
| Principal Means of T. | Rail (34.67%) | Rail (46%) | Car/Motorbike(77.6%) |
| Number of Means | 1,65 | 1,57 | 1 |
| Duration of the Trip(min.) | 47 | 52 | 29 |
| Distance | 24,5 km | 52 km | 12 km |
| Monthly cost for transport | € 68,82 | € 77,51 | € 58,63 |
| Incidence of transport costs on Income(%) | No Income (54.4%) | Less then 5% (55.5%) | N.A. (34.5%) |

Sample Characteristics BUSTO ARSIZIO



| | Students | Professors | T.A. Staff |
|--|-----------------|--------------------|--------------------------|
| Age | 24,6 | 52,5 | 54,5 |
| Gender | M (73%) | M (75%) | M (75%) |
| Day per Week | 4,6 | 4,8 | 4,87 |
| Principal Means of T. | Rail (53%) | Rail (63%) | Car/Motorbike (75%) |
| Number of Means | 1,86 | 1,87 | 1,5 |
| Duration of the Trip(min.) | 51 | 57 | 28 |
| Distance | 26,2 km | 41,1 km | 13,5 km |
| Monthly cost for transport | € 80,56 | €103,31 | € 62,75 |
| Incidence of transport costs on Income(%) | No Income (47%) | Less then 5% (50%) | Between 5% and 10% (50%) |

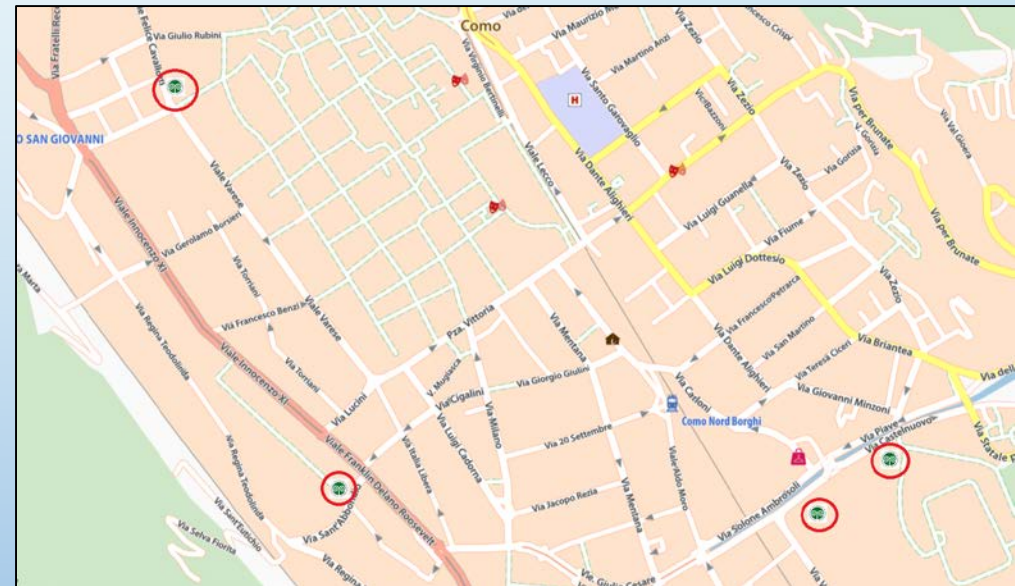
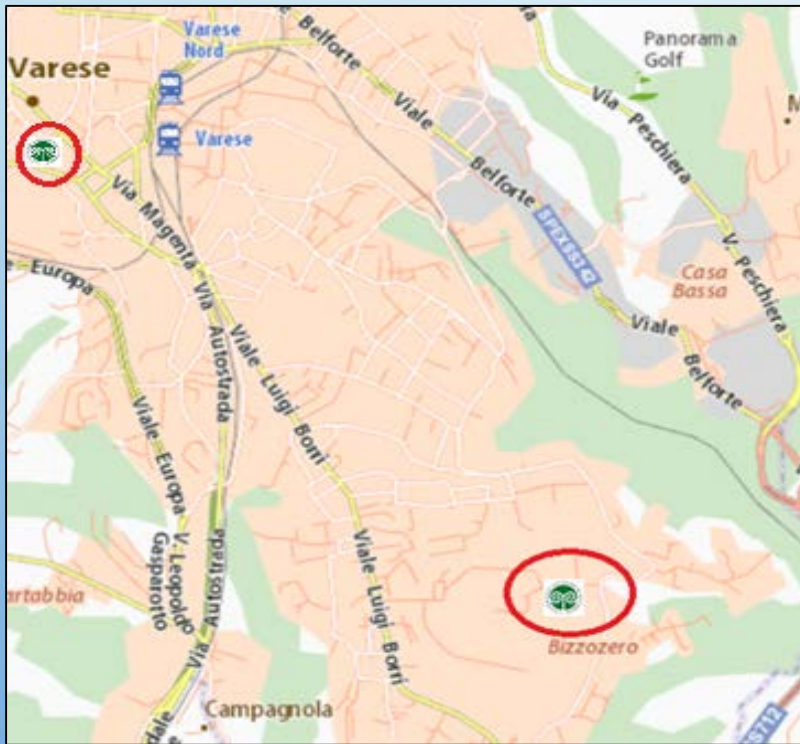
EVIDENCE OF CAR-DOMINANCE



UNINSUBRIA: A TALE OF TWO POLES?

Varese: Car dominant with a huge number of students and low quality public transport service. The campus is not in the centre of the city

Como: Public transport dominant with less students than Varese. No unique campus but more sites in the center of the city



METHODOLOGY

ECONOMETRIC APPROACH

MULTINOMIAL LOGIT (MNL)

- The MNL model is used to investigate the commuting mode choice of Uninsubria users
 - Travel habits (dependent variable) grouped into three modes with varying environmental impact: Rail (train); Road_C (urban bus, extra-urban bus, car riding); Road_S (car, motorbike)
 - Biking and walking modes are excluded (sensitive to short distances only)
- $U_{ij} = \alpha + \beta_j x_i + \varepsilon_{ij}$ \longrightarrow Utility from choice $j = (\text{Rail, Road_C, Road_S})$ for the individual user i
- Explanatory variables (x_i) including:
 - Quantitative data: age, frequency, minutes, costs
 - Categorical variables: user type (T.A. staff, students, professors); residence (VA, CO and OTHER); destination (Varese, Como); ownership of private cars; car pooling attitude; use of university shuttle bus (only Varese)
 - Residence dummy: respondents are clustered using administrative data (ISTAT and law 59/97) to account for proximity-effects among users

| VARIABLES | AGGREGATE (Pseudo R2: 0.3608) | | VARESE (Pseudo R2: 0.4103) | | COMO (Pseudo R2: 0.2410) | |
|--------------|----------------------------------|-------------------------|-------------------------------|-------------------------|-----------------------------|-------------------------|
| | Rail | Road_C | Rail | Road_C | Rail | Road_C |
| Age | -0.0532*** (0.0126) | -0.0481*** (0.0150) | -0.0789*** (0.0173) | -0.0576*** (0.0198) | -0.0231 (0.0187) | -0.0276 (0.0224) |
| Minutes | 0.0620*** (0.00407) | 0.0334*** (0.00431) | 0.0735*** (0.00532) | 0.0363*** (0.00589) | 0.0457*** (0.00684) | 0.0314*** (0.00736) |
| Frequency | 0.193*** (0.0517) | 0.290*** (0.0556) | 0.159** (0.0639) | 0.269*** (0.0694) | 0.248*** (0.0911) | 0.344*** (0.0983) |
| Cost | -0.00889*** (0.00232) | -0.0218*** (0.00253) | -0.00715** (0.00280) | -0.0232*** (0.00314) | -0.0136*** (0.00438) | -0.0177*** (0.00462) |
| Staff | -0.526 (0.424) | 0.475 (0.510) | 0.302 (0.512) | 0.583 (0.585) | -2.594*** (0.873) | 0.553 (1.194) |
| Student | -0.379 (0.410) | 0.649 (0.583) | -0.883 (0.556) | -0.166 (0.712) | -0.0638 (0.593) | 2.546** (1.204) |
| Car_own | -3.630*** (0.248) | -3.856*** (0.244) | -3.733*** (0.297) | -4.119*** (0.292) | -3.011*** (0.461) | -3.280*** (0.462) |
| Shuttle_bus | | | 1.463*** (0.162) | 1.022*** (0.180) | | |
| Car_pooling | -0.672*** (0.135) | -0.00465 (0.141) | -0.684*** (0.164) | 0.319* (0.179) | -0.760*** (0.243) | -0.542** (0.246) |
| VA | 0.655 (0.406) | 0.852*** (0.260) | -0.692** (0.338) | 0.886*** (0.238) | | |
| OTHER | 1.894*** (0.329) | 0.0819 (0.225) | | | 1.398*** (0.382) | -0.137 (0.307) |
| Varese | -1.668*** (0.155) | -1.864*** (0.168) | | | | |
| Constant | 0.354 (0.834) | 2.432** (0.988) | 0.943 (1.056) | 1.663 (1.253) | 0.269 (1.223) | -0.366 (1.713) |
| Observations | 2,586 | 2,586 | 1,914 | 1,914 | 672 | 672 |

Standard errors in parentheses; Significance levels: *** p<0.01, ** p<0.05, * p<0.1

PREDICTED PROBABILITIES

| | RAIL | ROAD_C | ROAD_S |
|------------------------------------|------------------------------|------------------------------|------------------------------|
| COMMUTING MODES (aggregate) | <i>Predicted probability</i> | <i>Predicted probability</i> | <i>Predicted probability</i> |
| | | | |
| CO#Como | 0.122*** | 0.436*** | 0.443*** |
| | (0.0326) | (0.0470) | (0.0481) |
| CO#Varese | 0.0430*** | 0.127*** | 0.830*** |
| | (0.0132) | (0.0253) | (0.0307) |
| OTHER#Como | 0.469*** | 0.275*** | 0.257*** |
| | (0.0288) | (0.0247) | (0.0241) |
| OTHER#Varese | 0.228*** | 0.110*** | 0.662*** |
| | (0.0166) | (0.0109) | (0.0195) |
| VA#Como | 0.138*** | 0.602*** | 0.261*** |
| | (0.0297) | (0.0466) | (0.0408) |
| VA#Varese | 0.0683*** | 0.246*** | 0.686*** |
| | (0.0159) | (0.0296) | (0.0347) |
| Observations | 697 | 440 | 1452 |

Standard errors in parentheses; Significance levels: *** p<0.01, ** p<0.05, * p<0.1

COLLECTIVE MODES AND PREFERENCES: HOW DO THEY DIFFER BETWEEN UNIVERSITY DESTINATIONS?

| | URBAN BUS | INTER-URBAN BUS | TRAIN |
|-------------------------------|-----------------------------|--------------------------------|-------------------------------|
| Motivation | Test (Como – Varese) | Test (Como – Varese) | Test (Como – Varese) |
| | Sample: Como=45 ; Varese=84 | Sample: Como= 133 ; Varese= 76 | Sample: Como=247 ; Varese=450 |
| Availability of private means | -1.23 | -3.34*** | -5.10*** |
| Economic convenience | 1.40 | -1.39 | -2.51** |
| Frequency service | 2.20** | -1.04 | 1.78 |
| Low travel time | 2.15** | 2.82** | 3.46*** |
| Intermodality | 1.89 * | 4.41*** | 1.67 |
| Stress level | 1.39 | 0.78 | 1.47 |
| Parking problems | 4.73*** | 6.16*** | 7.43*** |
| Environmental elements | 1.93* | 1.84 | 0.39 |
| Evaluation | | | |
| Affordability | 1.54 | -1.98* | -2.39** |
| Time reliability | -0.39 | -2.93*** | -1.13 |
| Information | 0.10 | -1.47 | -0.82 |
| Frequency | 1.84* | -2.06** | 0.05 |
| Tariff Integration | -0.47 | -4.39*** | -8.31*** |
| Intermodality | -1.15 | -3.30*** | -2.65** |

Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

CONCLUSIONS, POLICY IMPLICATIONS AND FUTURE RESEARCH

- The availability of parking in Varese and the ease to reach the university location by public transport in Como create, within a single survey, two different universes.
- In the complete regression model the predominance of the car obscure some effects that can be highlighted in the “Cities Models” (e.g. Staff)
- Cluster mode analysis: the trip origin influences the modal choice
- Different evaluation of public transport services by users in Varese with respect to Como.
- Policy implication: Accessibility of the campus of Varese, evaluation of possible policy to improve the use of sustainable means of transportation (according to the local authorities)
- Using GIS technique it could be possible to implement a Nested Logit model

**THANK YOU VERY
MUCH FOR YOUR
ATTENTION!**

ANY QUESTIONS?

