Supply and demand analysis for green crowdshipping

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XX Scientific Meeting, "Mobility and the city: policies for sustainability"
DAStU, Politecnico di Milano Milan, June 20th-22nd, 2018

Introduction (1/2)

- Sustainable Urban Freight Transport (UFT) Solutions

Introduction (2/2)

Crowdshipping: an innovative solution to UFT

"...is a sharing mobility service delivering goods via the crowd" (McKinnon, 2016)

- Is it capable to reduce congestion and polluting emissions?
  → usually it relies on dedicated trips with private motorized vehicles!

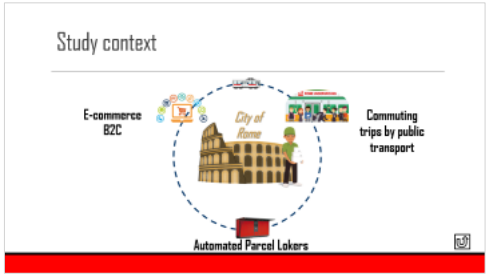
Green Crowdshipping

(use of non-dedicated public transport trips)

Research question

- under which conditions green crowdshippers will produce the service and the customers buy it?

Research project: green crowdshippers using the metro during their regular home-to-work trips in the city of Rome



Methodology

- Stated Preference Surveys
  - Bayesian D-Optimality efficient design developed using JMP (by SAS)
    - 4 different questionnaire blocks each including 3 choice exercises with 2 alternatives for a total of 24 different attribute levels' combinations.
  - ≈240 respondents
    - inhabitants of the city of Rome (demand-side survey)
    - metro users (supply-side survey)

Attributes and levels

Demand-side survey		Supply-side survey	
Features	Levels	Features	Levels
Shipping fee (with respect to current national shipping companies)	● Lower (+1) ● Typical (-1)	Location of APL	● Inside metro stations (+1) ● Outside metro stations/adjacent buildings (-1)
Shipping time (with respect to current national shipping companies)	● Lower (+1) ● Typical (-1)	Remuneration	● 3 €/delivery (+1) ● 1 €/delivery (-1)
Parcel tracking	● Available (+1) ● Not available (-1)	Delivery booking	● Real-time booking (+1) ● Off-line booking (-1)
Delivery date and Time schedule flexibility	● Yes (+1) ● No (-1)	Bank crediting modes	● Single delivery (+1) ● Every 5 deliveries (-1)

Utility specifications

MNL1 demand-side model:

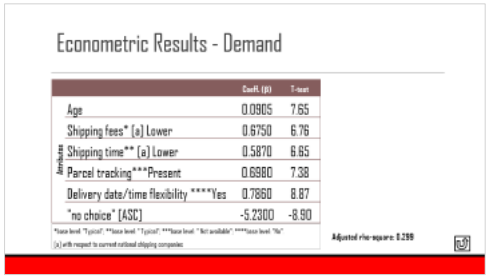
$$
\begin{aligned}
V_A &= \beta_1 * \text{Shipping Fees}_A + \beta_2 * \text{Shipping Times}_A + \beta_3 * \text{Parcel Tracking}_A + \beta_4 * \text{Delivery Planning}_A \\
V_B &= \beta_1 * \text{Shipping Fees}_B + \beta_2 * \text{Shipping Times}_B + \beta_3 * \text{Parcel Tracking}_B + \beta_4 * \text{Delivery Planning}_B \\
V_{\text{no choice}} &= \beta_5 * \text{Age} + \text{ASC}
\end{aligned}
\qquad (1)
$$

MNL2 supply-side model:

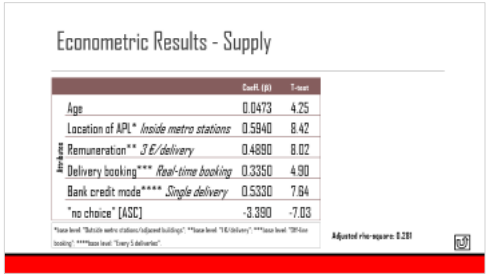
$$
\begin{aligned}
V_A &= \beta_1 * \text{Location of APL}_A + \beta_2 * \text{Remuneration}_A + \beta_3 * \text{Delivery booking}_A + \beta_4 * \text{Bank Credit Mode}_A \\
V_B &= \beta_1 * \text{Location of APL}_B + \beta_2 * \text{Remuneration}_B + \beta_3 * \text{Delivery booking}_B + \beta_4 * \text{Bank Credit Mode}_B \\
V_{\text{no choice}} &= \beta_5 * \text{Age} + \text{ASC}
\end{aligned}
\qquad (2)
$$

Econometric Results

- DEMAND

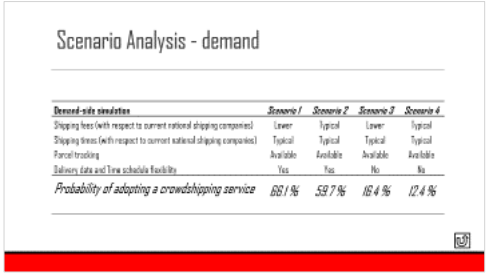


- SUPPLY

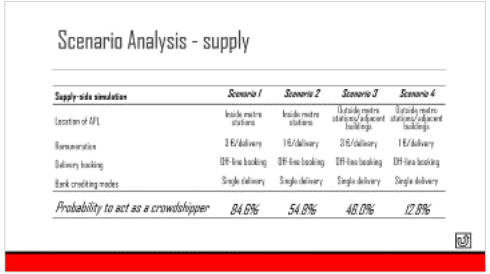


Scenario Analysis

- DEMAND



- SUPPLY



Implications (1/3)

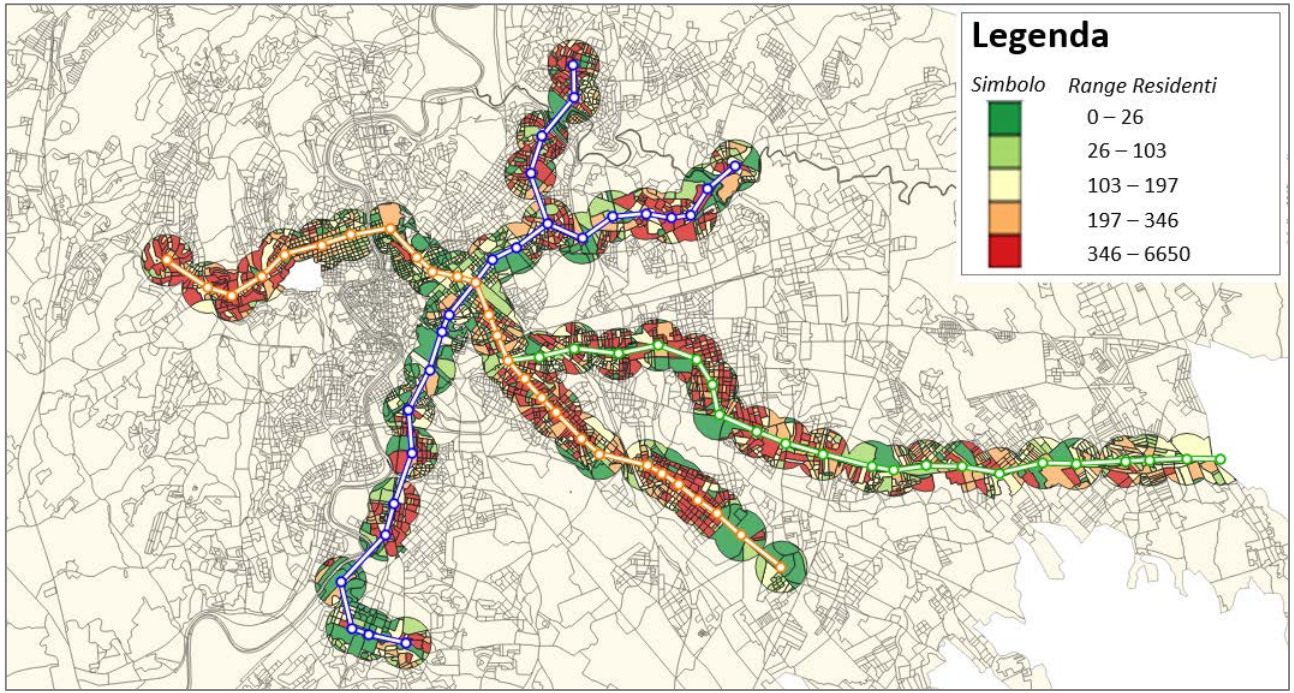
$$Eshopping\ rate\ \left[\frac{orders}{day\ inhab}\right]$$
$$= \frac{\left(Web\ Shopper\ [\%] * Physical\ shipment[\%] * Ecommerce\ frequency\ \left[\frac{orders}{year\ inhab}\right]\right)}{250}$$
$$= 0.0262$$

where:

- Web Shopper is the percentage of the population making at least one online purchase;
- Physical shipment is the percentage of orders requiring a physical shipment;
- E-commerce frequency is the annual average frequency of online purchase;
- 250 is the number of days in one year, excluding week-end days and public holidays.

(Netcomm, 2016; 2017)

Implications (2/3)



inhabitants located in the surrounding area of the metro stations (adopting a catchment area of 800m radius for each stop

Implications (3/3)

Demand SCENARIOS	Metro users* [users/peak hour]	Inhabitants**	Probability to adopt crowdshipping service	Potential demand [orders/day]
SCENARIO 1	113’347	647’154	66.10%	14'100
SCENARIO 2			59.70%	12'730
SCENARIO 3			16.40%	3'500
SCENARIO 4			12.40%	2'640
Supply SCENARIOS	Metro users* [users/peak hour]		Probability to act as a crowdshippers	Potential crowdshippers [crowdshippers/day]
SCENARIO 1	113’347		84.6%	38’350
SCENARIO 2			54.8%	24’840
SCENARIO 3			46.0%	20’850
SCENARIO 4			12.8%	5’800

*Users of the Rome’s metro lines during the peak hour (Roma Mobilità, STATUS 2016).
**Inhabitants in the 800’meters catchment area (elaboration from census data ISTAT 2011, https://www.istat.it/it/archivio/104317).

Conclusions

- APLs location is the most relevant feature (more than remuneration)
- The possibility to plan the delivery date and its time schedule has the highest impact on consumers' utility
- Comparing demand/supply ⟶ the service can rely on a sufficiently large base of potential crowdshippers so to be able to manage a substantial number of delivery requests
- There is a potential market for the new service and it is important to pay attention to its design

On-going research endeavours

- Quantifying the environmental effects via Traffic Simulation Modelling
- Test a real-life pilot study (interlibrary loans)
  - Financial, contractual, legal (etc.) aspects
- Including Crowdshipping in the SUMP-logistic in Rome

THANKS FOR THE ATTENTION

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