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Urban freight transport and policy changes: Improving decision makers' awareness via an agent-specific approach

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ABSTRACT

This paper derives policy implications from agent-specific data with respect to the implementation of policy changes in the case of urban freight transport. In particular, the research, based on the case of Rome's Limited Traffic Zone, discusses alternative policy scenarios. After describing attribute definition and selection, questionnaire administration, data collection and treatment, willingness to pay estimates are calculated.

The paper tests, from a policy-maker's perspective, the implications deriving from the presence of inter-agent heterogeneity and the specific policy composition of an improving and equally impacting interventions on all agent-types' utility. The paper shows how an agent-specific approach might increase decision makers' awareness and help taking better decisions.

1. Introduction

Local decision makers often alter the extant urban freight transport (UFT) regulatory framework with the intent of improving urban freight distribution. Policy changes aim to, among other objectives, reduce the amount of pollutants emitted, minimise the interference between passenger and freight transport during overlapping peak hours, guarantee high liveability standards within the urban environment, satisfy the structural import needs of goods characterising the normal city functioning and development. The success of UFT innovative measures is influenced by local policy planners' knowledge and awareness (Lindholm and Blinge, 2014). Decision makers often adopt coarse and undifferentiated policies without reliable forecasts of effects among the agent-types impacted.

The paper tests, from a policy-maker's perspective, the implications deriving from the presence of inter-agent heterogeneity and the composition effect of an improving and equally impacting policy on the utility of all agent-types considered.

The paper is structured as follows. Section 2 reports a succinct literature review describing the limited number of papers adopting this specific research perspective while underlining its high informative potential. Section 3 describes questionnaire development and administration while Section 4 presents econometric results and discusses their policy implications. Section 5 concludes.

2. Literature review

This section reports a succinct yet updated literature review. A recent systematic investigation with respect to articles focusing on UFT research and their relative citations detected a substantial increase in the attention devoted to these themes in specialised literature (Gatta and Marcucci, 2013a). UFT research activities, as approximated by high quality publications indexed in the ISI Web of Knowledge database, are concentrated in the USA followed by UK, Spain and Italy. A relatively high number of review articles, recently appeared (e.g. Cherrett et al., 2012, Lindholm and Behrends, 2012; Nuzzolo et al., 2013; Woodburn, 2012) underline the still enduring need of clarification, classification and, as suggested by Anand et al. (2012), clear ontological demarcation of what UFT research is. A thematic clustering of articles can be performed with respect to the following issues: (1) freight vehicle routing and efficiency maximisation (e.g. Hemmelmayr et al., 2012; Motraghi and Marinov, 2012; Pillac et al., 2012); (2) UFT regulation and environmental impact analysis (e.g. Arvidsson, 2013; Figliozzi, 2011; Lee et al., 2012; Sathaye et al., 2010a, 2010b); (3) data acquisition (e.g. Allen et al., 2012; McCabe et al., 2013; Roorda, 2011); (4) disruption analysis (e.g. Friesz et al., 2011; Mamasis et al., 2013); (5) multi-agent modelling (e.g. Ballantyne et al., 2013, Teo et al., 2012).

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Notwithstanding influential researchers have explicitly acknowledged the important role behaviourally consistent and agent-specific approach play in modelling UFT policy impacts (e.g. de Jong and Ben-Akiva, 2007; Hensher and Figliozzi, 2007; Holguín-Veras et al., 2013; Roorda et al., 2010), only a limited number of UFT related papers have adopted such a perspective both when acquiring data as well as when using them for model estimation. (e.g. Gatta and Marcucci, 2013b; Domínguez et al., 2012; Jaller and Holguín-Veras, 2013; Marcucci and Gatta, 2013, 2014; Marcucci et al., 2012, 2013; Stathopoulos et al., 2011, 2012).

Behavioural freight models constitute a sub-set of disaggregate models that assume stakeholders strive to maximise utility. Freight movements can be rationalised by analysing the underlying motivations stemming from the relative convenience each stakeholder derives from the choice made. These reflexions are crucial to optimise UFT policy effects from a policy-maker's perspective. In fact, they help forecasting regulatory changes impacts on agents' behaviour explicitly considering: inter-agent heterogeneity, optimised policy characteristic on revenue maximisation and equally impacting comprehensive effects on all agent-types' utility.

3. Questionnaire development and administration

The results reported in this paper originate from a research project, funded by Volvo Research Foundation (2009) and the Italian Ministry of Research (2008), on methods for assessing the efficiency of freight distribution in Rome's Limited Traffic Zone (LTZ). The research aimed at defining a knowledge base to optimise UFT policies. In fact, policy interventions so far implemented in Rome's LTZ, in particular, and in Italian cities, in general, have often generated unsatisfactory results. This is mainly due to the inadequate consideration paid to behavioural issues. The sequential interactions generated by policy changes are considered marginal if not completely negligible. On the contrary, an in-depth analysis of specific agent-types' characteristics and preferences should represent a fundamental tenet when investigating system performance. The agent-types examined are: transport providers, retailers and own-account operators.[1] The project developed an appropriate stated preference exercise to acquire the necessary data to accurately estimate the most likely effects of the policies implemented.

The central component of the questionnaire refers to a set of stated ranking exercises. This response format was adopted since the choice set included policies rather goods or services. Additionally, it was assumed more logically consistent to ask for a ranking of policies rather than probe interviewees to choose them since this, *de facto*, never happens in reality. Selection of attributes and levels definition were based on: literature survey (e.g. Browne et al., 2007; Button, 1993; Munuzuri et al., 2005; Ogden, 1992), previous quantitative studies performed in the city of Rome (i.e. Filippi and Campagna, 2008; STA, 1999) and focus group meetings with stakeholders (Stathopoulos et al., 2011). In particular, an extensive review of the city logistics literature was useful to individuate possible UFT measures, while previous studies performed in the city of Rome indicated a set of potentially conflicting policy components when considered from the perspective of each agent-type. Finally, focus group meetings with stakeholders provided an important contribution to attribute definition. The attributes selected were considered the most appropriate to tackle the city logistics problems.

Table 1
Attribute levels and ranges used in the SP experiments by agent-type.

Attribute	Level and range of attribute	Own-account	Retailers	Transport providers
Number of loading/unloading bays	400 800 1200	✓	✓	✓
Probability to find loading/unloading bays free (%)	10 20 30	✓	✓	✓
Time windows	Open: (18:00–08:00) & (14:00–16:00) Open: (20:00–10:00) & (14:00–16:00) Open: (04:00–20:00)	✓		
Annual entrance fee (€/year)	200 400 600 800 1000	✓	✓	✓

Note: the underlined attribute-levels represent the status quo level.

A set of critical issues were identified: loading/unloading bays (too few, illegal occupation, lack of surveillance, inadequate structure), time windows (too many exceptions in the current regulatory framework) and entrance fee (too high or in need of a different articulation according to vehicle categories).

The attribute included in the ranking exercises had to satisfy the following criteria: (1) be salient for the majority of respondents; (2) obtain shared support among respondents; (3) considered credible from a respondents' perspective; (4) reflect plausible changes to the current scenario. Six attributes were preliminary selected and tested in a pilot study. These were (1) number of loading/unloading bays (LUB); (2) probability to find loading/unloading bays free (PLUBF); (3) time windows (TW); (4) annual entrance fee (EF); (5) exemption from time windows; (6) exemptions from entrance fees.

The three agent-types consulted had different needs and sensitivities. This paved the way to the definition of an agent-specific questionnaire. Time windows were included only for own-account operators since they did not provide plausible econometric estimates for both transport providers and retailers.[2] The two “exemption” attributes were eliminated due to the difficulty in determining their correct interaction with the remaining attributes. Table 1 reports the levels and ranges used to characterise the four attributes used.

The questionnaire administered was optimised according to a d-efficient measure,[3] spanned four waves, using whenever appropriate a blocking strategy,[4] each incorporating a change in the structure of the design that benefitted from previous findings (i.e. estimated coefficients available for each attribute and agent-type).

[1] Three are the main facets characterising an own-account operator according to Italian legislastion. In particular, freight transportation should: not be the operators' main activity, be the proprietor of the goods transported and be the owner/lessee of the vehicles used.

[2] In fact, transport providers and retailers, de facto, abided by no time window restrictions.

[3] For more details please refer to Rose and Bliemer (2005).

[4] Blocking was used since the experimental design necessitated administering more exercises than we, for practical reasons, could pose to each respondent. For an in-depth description please refer to Johnson et al. (2013), p. 7–8.