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HOW GOOD ARE RETAILERS IN PREDICTING TRANSPORT PROVIDERS' PREFERENCES FOR URBAN FREIGHT POLICIES?… AND VICE VERSA?

Edoardo Marcucci [1*], Valerio Gatta [2]

[1] *University of Roma Tre, Italy*
[2] *University of Roma Tre, Italy*

Abstract

The success or failure of urban freight transport measures crucially depends on local policy makers' knowledge and awareness of stakeholders' preferences. The behavioral approach calls for stakeholder-specific data acquisition and model estimation. Considering the cost and time to perform an appropriate data acquisition process and the ever present aim of compressing research costs, it is important to investigate innovative data acquisition procedures that can satisfy the above mentioned constraints while not sacrificing data quality. The paper tests the capability of an alternative, less expensive and faster to administer procedure of acquiring stakeholder-specific data capable of reproducing policy evaluation results (i.e. willingness to pay measures) derivable from a standard data acquisition process. In more detail, the paper investigates the respective capabilities retailers and transport providers have in predicting each other responses to a stated ranking exercise aimed at measuring agents' preferences for alternative urban freight policies for the limited traffic zone in the city center of Rome. Results show that retailers are capable of predicting with a good level of accuracy transport providers' preferences for a given policy while the opposite is not true. This represents an important step forward in willingness to pay estimation for policy changes when the substitution rates between the various attributes considered are the main research objective of a strategic level analysis. Were this possible one could, in fact, interview retailers alone to understand also which would be transport providers' preferences for the policies evaluated.

Keywords: urban freight transport, policy evaluation, willingness to pay, stated preference, data acquisition, stakeholders' forecasts.

1. Introduction

Cities are structural net importer of goods. Urban freight transport (UFT) is essential to guarantee high standards of livings but it also produces, as a side effect, relevant undesirable social costs. Ensuring an efficient UFT is both a fundamental and daunting task local policy makers have to tackle. They implement policies altering the

[*] Autore a cui spedire la corrispondenza: Edoardo Marcucci (edoardo.marcucci@tlc.uniroma3.it)

extant UFT regulatory framework with the intent of improving the functioning of the freight distribution system. Policy changes usually aim, among other objectives, at compressing the amount of pollutants emitted, minimizing the interference between passenger and freight during peak hours, reducing the number of circulating vehicles and/or kilometers driven while satisfying city dwellers' needs. The success of UFT innovative measures crucially depends on local policy makers' knowledge and awareness of stakeholders' preferences (Lindholm and Blinge, 2014). Limited knowledge often results in coarse and undifferentiated policies that can backfire when reliable forecasts of policy effects for the various stakeholders impacted are not available (Givoni, 2014).

The need *for* and potential benefits deriving *from* a stakeholder-specific approach have been studied by the Authors in a series of papers that are succinctly summarized below: 1) Marcucci et al. (2012) report on the survey instrument development process to study freight agents' behavior, describe the stated preference experiment used to acquire the data employed in this paper and discuss the multi-stage efficient experimental design implemented incorporating stakeholder-specific priors so to guarantee a high quality data acquisition process; 2) Gatta and Marcucci (2013) point out the importance and implications of adopting a stakeholder-specific efficient design strategy to elicit stakeholders' preferences when evaluating alternative UFT policies, and show that the biases in willingness to pay (WTP) estimates are substantial when inappropriate stakeholder-generic data acquisition approach is adopted. In fact, ex-post stakeholder-specific model estimation cannot compensate for a stakeholder-generic data acquisition procedure. Once committed, the original sin cannot be redeemed; 3) Marcucci and Gatta (2013) study own-account operators to investigate the impact time windows restrictions have on their behavior and clarifying the relevance of this regulatory feature; 4) Marcucci and Gatta (2014) focus on retailers concentrating on the role of the status quo and test for non-linear attribute effects in order to capture their specific characteristics; 5) Gatta and Marcucci (2014) illustrate, from a policy-maker's perspective, a method, accounting for the heterogeneity among own-account operators, retailers and transport providers, to define an acceptable and improving policy change equally impacting the stakeholders involved.

The results obtained so far underline the relevance a stakeholder-specific approach plays both when acquiring data as well as when estimating choice models with the intent of calculating WTP measures for the policies considered. In particular, one has to note that stated preference data are costly to acquire when using face-to-face interviews. Unfortunately this is exactly the case often occurring when analyzing policy effects in this sector. In fact, mostly due to confidentiality issues, it is hard to get stakeholders replying to the lengthy questionnaires researchers need to administer. In fact, many are the elements possibly impacting the evaluation of a given policy; among this one can, for instance, recall: sector of activity, frequency of delivery, closeness of a loading bay, location and dimension of warehousing facilities. All these considerations specifically apply and are reinforced when one has to account also for the peculiarities characterizing different stakeholders. More in detail, the studies previously cited suggest that heterogeneity among stakeholders can be extremely important in influencing effective policy impacts. While the considerations expressed concerning the cost and difficulties of acquiring stakeholder-specific data generally apply, their pertinence is not homogeneous. Additionally, based on our research experience in the city of Rome, it is much more difficult, costly and time consuming to get high-quality and reliable

information from transport providers with respect to retailers. This is mostly due to the time pressure characterizing transport providers' work schedules and the location of their headquarters that are usually outside city boundaries and far apart one from the other. Given these characteristics one has to make specific appointments and dedicated trips thus increasing the cost and time needed to perform each interview.

Given the need of acquiring stakeholder-specific data, considering the cost and time to perform data acquisition and the ever present aim of compressing research costs, it is important to investigate innovative procedures that can satisfy all the above mentioned constraints while not sacrificing data quality.

The present paper tests the capability of an alternative, less expensive and faster to administer procedure of acquiring stakeholder-specific data capable of reproducing policy evaluation results (i.e. WTP measures) derivable from a standard data acquisition process. In other words, the paper assesses stakeholders' forecasting capabilities in predicting their counterparts' evaluation of alternative policy changes. In essence, the paper tests if one can economize in the data acquisition phase by asking only transport providers or retailers which policy the other would choose, instead of having to interview them both. In fact, should one discover that a given stakeholder is capable of predicting her counterpart's choices one could interview this stakeholder only.

The paper is structured as follows. The literature review focuses on behavioral approaches for UFT policy evaluation. Data description illustrates both the standard and alternative data acquisition process employed. Econometric results and discussion compares the alternative results derivable from the two data acquisition methods and their practical implications. The final section concludes, illustrates possible weaknesses and shortcomings of alternative methods and proposes future research endeavors to verify the robustness of results and their transferability.

2. Literature review

Urban freight issues are strictly entwined *with* and dependent *on* innovations in technology, organization, regulation and policy. The results produced by any change in each of these realms have to be considered with respect to those occurring in the others. In fact, in a complex system such us UFT the end results of a given change in a relevant variable depend on the strategic interaction taking place with the other components of the system. The various stakeholders interacting in the complex UFT system often have contrasting objectives and the various experiments indicate that no one-solution-fits-all is readily available. These considerations suggest proceeding to a stakeholder-specific evaluation of the policies considered for implementation.

Economic growth, efficiency, and environmental sustainability represent the fundamental and often conflicting tenets of a flourishing city. Reconciling them is a daunting task and success can only be reached if stakeholders' deep-rooted preferences and behaviors are first understood and, subsequently, modified.

Freight movements should be examined and comprehended inquiring their underlying motivations that can possibly be discovered examining the relative convenience each stakeholder has when making a choice. This framework of analysis is useful when exploring the effects of different policy mixes, concentrating on specific constraints (e.g. time windows) and considering alternative incentives (e.g. price rebates for new vehicles). Policies' potential impacts are best forecasted when jointly pondering both policy makers' available tools and the elements affecting freight operators (Puckett

and Greaves, 2009). One needs to identify both incentives and disincentives stakeholders consider acceptable, so to quantify the impact they might produce on the status quo. Hensher and Figliozzi (2007) argue that standard approaches where the complexity of freight movements is not explicitly considered are essentially incapable of predicting the most probable reactions to policies perturbing the status quo.

Not all behavioral models explicitly consider stakeholders' utility maximization efforts[1] which are embedded in a micro-economic theoretical framework. On the contrary, stated preferences are used to estimate stakeholders' choice exactly on the base of consumer theory (Marcucci, 2005; Gatta, 2006), assuming an unambiguous identification of the decision maker.

To sum up, for a behaviorally consistent UFT policy evaluation, a stakeholder-specific stated preference perspective is essential (e.g. de Oliveira, 2012; Dominguez et al., 2012; Gatta and Marcucci, 2013; Holguin-Veras et al., 2007, 2008; Marcucci and Gatta, 2013, 2014; Marcucci et al., 2007, 2013, 2015; Stathopoulos et al., 2012). However, no systematic UFT activity survey is available (Ruesch and Glùcker, 2001) and stakeholder-specific analysis of UFT policies is fundamentally under-researched notwithstanding policy makers' demand for such type of knowledge. In fact, they are interested in securing this information before implementing a given policy since this would greatly help forecasting the most likely reactions and predict the achievement of the desired objectives. Data needs are habitually higher than their obtainability (Samimi et al., 2009).

3. Data description

The paper explores whether and how much retailers and transport providers are capable of predicting each other's preferences when responding to a stated ranking exercise concerning innovative UFT policies to be implemented in the limited traffic zone in Rome.

A total of 66 transport providers and 90 retailers were interviewed. They were asked to respond to a hypothetical scenario defined on the base of an optimized experimental design (see Marcucci et al., 2013 for details) simulating the possible introduction of a new UFT policy. When interviewing retailers/transport providers they were not only asked to reply to the questionnaire for themselves but were also requested to answer taking their respective counterparts' perspective. In fact, the interviewees were also asked to rank the policy options after reading the following statement "Now, please rank the options trying to forecast how your most relevant business partner would order them" (see Figure 1).

Attribute definition, selection and optimization are discussed in other papers reporting a detailed description of the Bayesian efficient design developed (Marcucci et al., 2013; Stathopoulos et al., 2011). The attributes considered are: 1) number of loading bays; 2) probability of finding a loading and unloading bay free; 3) entrance fee. Number of loading bays and the probability of finding them free have three levels while access fee has five. The ranges adopted were defined after a set of focus groups and a frank debate with experts and policy makers. The minimum level for loading bays and the probability of finding them free coincides with the current situation. In other words,

[1] For example agent-based models can describe and forecast stakeholders' behavior assuming deterministic utility functions (Liedtke and Schepperle, 2004).

the policy scenarios tested only explore improvements with respect to the status quo. Entrance fee, on the contrary, was characterized by a wider and symmetric range of variation with respect to the situation present when the questionnaire was administered[2].

During the process of attribute and level definition, notwithstanding the stakeholder-specific approach adopted, a high level of shared consideration and pertinence for all stakeholders was always searched for and, at least in our opinion, guaranteed. This choice was driven by the acknowledgement that UFT policies are regularly and equally applied to all stakeholders. The stated ranking exercises reported three policy options always including the status quo alternative.

	Policy 1	**Policy 2**	**Status Quo**
Number of loading bays	400	800	400
Probability of finding loading bays free	20%	10%	10%
Entrance fee	1000 €	200 €	600 €
Policy ranking (OWN)	❑	❑	❑
Policy ranking (YOUR COUNTERPART)	❑	❑	❑

Figure 1. Example of a stated ranking exercise

4. Results and discussion

This paragraph discusses and compares the results obtained using the data acquired via the standard and the innovative data attainment process with respect to the policies considered. While aware of heterogeneity[3] and non-linearity[4] issues, in general, and with respect to this dataset, in particular, (please see Marcucci and Gatta, 2013, 2014; Marcucci et al., 2015) the paper concentrates on multinomial logit estimates only representing the benchmark model.

The analysis tests whether retailers, transport providers or both are capable or not to predict their counterpart's choices. In order to do so, the paper compares actual transport providers' preferences with those forecasted by retailers (see Table 1) and actual retailers' preferences with those forecasted by transport providers (see Table 2). In order to avoid scale related issues the comparison is performed using both point estimates of WTP measures as well as their confidence intervals calculated by the Delta

[2] Wide-ranging levels were used to circumvent imaginable behavioral misinterpretations. In fact, insufficient variation in level ranges can have imperceptible impact on utility that can mistakenly be interpreted as evidence of a non-trading behavior. Meetings with all the stakeholders produced relevant information with respect to realistic and perceptible attribute ranges.

[3] Heterogeneity can be explored by investigating the systematic, stochastic or systematic and stochastic components of the utility function (Marcucci and Gatta, 2012).

[4] Rotaris et al. (2012) illustrate the various techniques for testing non-linearity. Moreover, non-linear effects on utility function can be also tested via self-stated attribute cutoffs (Marcucci and Gatta, 2011).

method[5] (see Figure 1 and 2). In a choice modelling framework, the WTP for a given attribute can be obtained dividing its marginal coefficient by that of cost (i.e. entrance fee).

In Table 1, the model for transport providers shows a good fit to the data (Pseudo-R^2 = 0.25) and all coefficients are statistically significant with the expected sign. In particular, both loading bays and probability of finding loading bays free have a positive coefficient since an increase in these variables has a positive impact on utility. On the contrary, an increase in the entrance fee, the variable with the highest explanatory power, has a negative impact on utility. The alternative-specific constants related to the two unlabeled hypothetical situations are positive revealing an a priori aversion to the status quo alternative. Similar considerations apply when looking at the model reporting retailers' predictions of transport providers' preferences. The value of an additional loading bay, looking at the WTP column in Table 1, is 0.24€ while transport providers are willing to pay 7.43€ for a one percent increase in the probability of finding loading bays free. Retailers' forecasts slightly underestimate transport providers' WTP (0.22€ and 7.15€), representing a slight bias of 8% for loading bays and 4% for the probability of finding loading bays free. As an example, assuming an intervention policy aiming at providing 400 additional loading bays, the maximum increase in entrance fees that a policy maker can impose leaving transport providers indifferent is 96€. Relying, instead of retailers' forecasts, the maximum increase would be equal to 88€.

Table 1. Model estimates: actual transport providers' preferences and forecasts by retailers

	ACTUAL MODEL transport providers' preferences		*PREDICTED MODEL transport providers' preferences forecasted by retailers*		*WTP measures (€)*		
Variable	*Coefficient*	*t-stat.*	*Coefficient*	*t-stat.*	*Actual*	*Predicted*	*Delta*
Number of loading bays	0.0014	9.16	0.0010	6.51	0.24	0.22	-0.02
Probability of free loading bays	0.0435	6.31	0.0307	4.85	7.43	7.15	-0.28
Entrance fee	-0.0058	-16.85	-0.0043	-18.30			
Alt1 constant	0.6860	3.97	0.6106	4.68			
Alt2 constant	0.7086	4.46	0.4388	3.58			
Pseudo-R^2	0.25		0.19				
Log-likelihood	-690.6266		-1046.8210				
Observations	1128		1629				

Table 2 refers to retailers' preferences. The two models show satisfactory fit to the data. Also in this case all coefficients are statistically significant and with the expected sign. Retailers are willing to pay an additional loading bay 0.18€ and 9.93€ for an additional 1% probability of finding loading bays free, while transport providers'-

[5] Following Gatta et al. (2014) we also employed alternative methods for constructing WTP confidence intervals (e.g. Likelihood Ratio Test Inversion method; Fieller method; Bootstrap Percentile method; etc.). No substantial differences were detected and the results obtained, using the Delta method, were confirmed.

based forecasts would suggest substantially biased WTP measures of 0.25€ and 6.84€ representing an overestimation of 39% for the former and an underestimation of 31% for the latter. Taking the same example discussed above (i.e. 400 additional loading bays), trusting on transport providers' forecasts, a policy maker would increase the entrance fees for retailers of 100€ causing grave discontent to them in fact, according to their stated preferences, they would be willing to pay additional 72€ (=0.18€*400). Transport providers' forecasts provide a relevant distortion also when considering the probability of finding loading bays free: assuming, for example, a policy intervention capable of raising the probability of finding loading bays free of 10%, the model results would suggest to increase the entrance fees for retailers of 68€ while actually they would be willing to pay 99€ translating to significant less public revenues.

Looking at the two stakeholders' models based on own responses, one notices diverse WTP patterns. In fact, they have contrasting sensitivities. Transport providers are more interested in the number of loading bays and less in the probability of finding them free with respect to retailers (WTP measures are, respectively: 0.24€ versus 0.18€ and 7.43€ versus 9.93€). A possible motivation of the distortion derived from the transport providers' low capability in predicting retailers' preferences is the tendency to project their own preference structure on their counterpart. In fact, transport providers think that retailers are mostly concerned about the number of loading bays while this is not confirmed by the estimates based on retailers' choices. This does not apply the other way around. In fact, retailers seem to be able to dissociate from their own preferences when asked to respond from a transport provider's point of view and are also capable of predicting their counterparts' preferences.

It remains an open question for future research both the test for the robustness of these results (e.g. extend the number of interviews and test this approach in other cities/locations) as well as the inquiry of the motivations of these phenomenon.

Table 2. Model estimates: actual retailers' preferences and forecasts by transport providers

	ACTUAL MODEL retailers' preferences		*PREDICTED MODEL retailers' preferences forecasted by transport providers*		*WTP measures (€)*		
Variable	*Coefficient*	*t-stat.*	*Coefficient*	*t-stat.*	*Actual*	*Predicted*	*Delta*
Number of loading bays	0.0006	5.21	0.0013	7.29	0.18	0.25	+0.07
Probability of free loading bays	0.0347	6.51	0.0356	4.61	9.93	6.84	-3.09
Entrance fee	-0.0035	-16.44	-0.0052	-15.30			
Alt1 constant	0.8244	5.32	0.5451	3.69			
Alt2 constant	0.6579	4.82	0.6623	4.57			
Pseudo-R^2	0.15		0.23				
Log-likelihood	-1126.9350		-715.2422				
Observations	1624		1164				

To sum up, retailers seem capable of predicting with a good level of accuracy transport providers' preferences for a given UFT policy while the opposite is not true.

This can possibly be due to the difference in sample size that is approximately 30% larger for retailers.

A graphical illustration is reported in Figure 2 and 3 where the WTP distributions and confidence intervals are reported. In fact, in the case of retailers, their forecasted WTP point estimates fall within transport providers' WTP confidence intervals for both policy attributes considered. On the contrary, transport providers' forecasted WTP point estimates fall outside the two retailers' WTP confidence intervals. From a practical point of view it is important to note that since retailers seem capable of predicting transport providers' preferences, research costs could be substantially compressed due to the higher relative cost transport providers' interviews have with respect to retailers' ones.

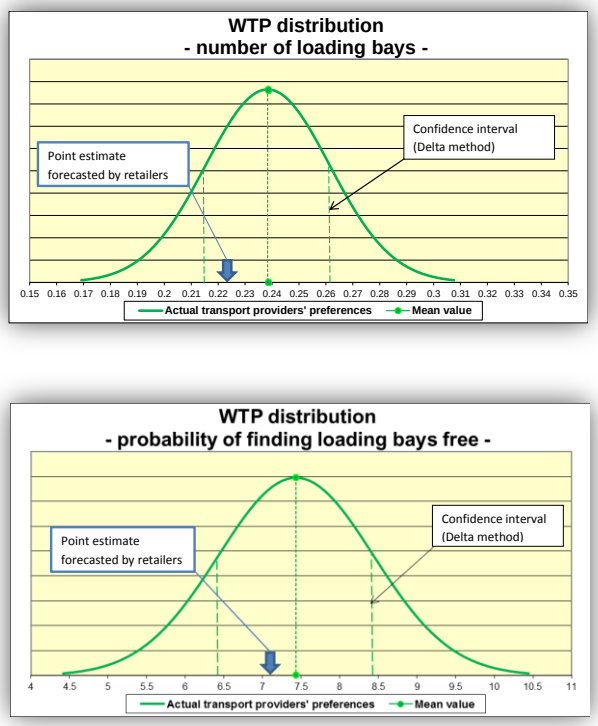

Figure 2. WTP distribution: actual transport providers' preferences and forecasts by retailers.

The use of appropriate covariates was tested to check if each stakeholder's predictive capability could be improved. The covariates used are: 1) freight sector; 2) number of transport providers serving the shop, for retailers and 1) freight sector served; 2) number of clients served, for transport providers. The results obtained for retailers and transport providers, not reported, do not provide any relevant improvement. While one cannot exclude that this might be due to the small dimension of the sample investigated, that is further reduced once homogeneous partitions are taken using the above mentioned covariates, one could assume that heterogeneity in the sample helps improving predictive capabilities.

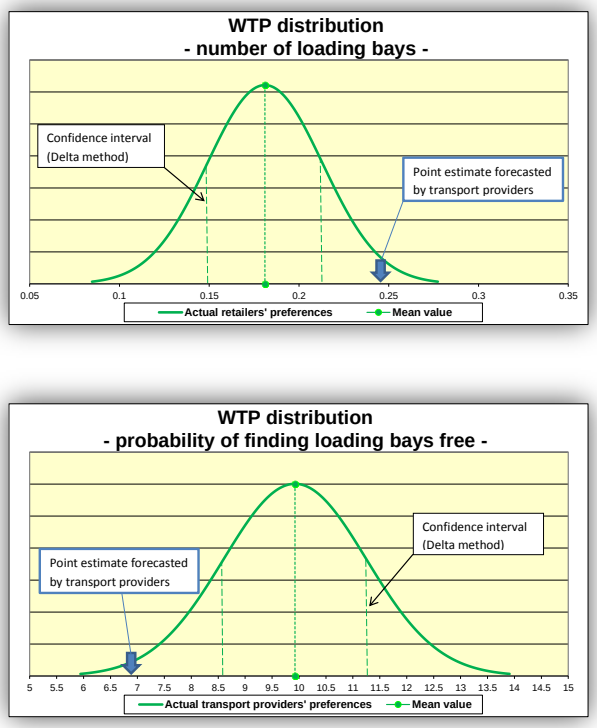

Figure 3. WTP distribution: actual retailers' preferences and forecasts by transport providers

5. Conclusions

The results reported are important and contribute to the literature since, strictly with respect to the sample of agents interviewed and the city considered, one could confidently interview retailers alone to understand also which would be transport providers' preferences for the UFT policies evaluated. This represents an important step forward in WTP estimation for policy changes when the substitution rates between the various attributes considered are the main research objective for a strategic level of analysis. However, one has also to recall that, given the role transport providers' socio-economic characteristics play in explaining preference heterogeneity, the decision to interview transport providers too should depend on the comparison of cost and time bearings with respect to the additional information made available. In other words, there might be specific research contexts where administering interviews to both urban freight agents is the best option. However, in all those cases where only substitution rates between attributes are of interest a simpler, faster and less expensive questionnaire administration process could be implemented without loosing precious information.

It is appropriate to underline that these results while important for reducing, in principle, data acquisition time and costs are only valid with respect to the policy and city considered. Future research should investigate the robustness and the transferability of the results obtained.

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