Accounting for the effect of rescheduling possibilities in the departure time choice using an efficient stated preference design

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Extended abstract

Urban congestion still represents one of the most relevant problems of the modern societies. Among the several travel dimensions that play a role in travel congestion, the departure time is the most important. A number of studies have in fact shown that people are more likely to change their departure time to address the problem of congestion rather than changing mode (Hendrickson & Planke, 1984; Kroes et al., 1996; Hess et al., 2007a; Arellana *et al*., 2012) or even less change work and residential location. Despite there are already evidences on departure time choices, as highlighted in Ortúzar et al. (2013), more research is still needed.

In particular a crucial problem when studying departure time is that the choice of when to realize a given trip is (often) related to the full daily activity pattern, such as a restriction or a preference in one activity may form restrictions in the flexibility of other activities and thereby affect the preference for the related departure time. This is particularly true when there are intermediate stops and when activities are performed jointly with other people, typically other members of the family. In this context, it is of particular relevance to have in-depth knowledge about the structure of the daily activity schedule and the flexibility of all the related trips. Previous studies (de Jong et al., 2003; Hess et al., 2007b; Arellana et al., 2012) have included the activity participation time of the main activity, but they usually refer only to the time spent at work. Previous studies (Börjesson, 2008; Arellana et al., 2012) have also included general questions regarding the flexibility of work, but none has explored in depth the flexibility of the daily scheduling process and to which extent this affects individuals' preferences for departure time.

The purpose of this research is to contribute to the recent works in the departure time in studying whether individuals' preferences for departure time and willingness to pay vary depending on the rescheduling possibilities among activities, in terms of time of the day, location and substitution of the activity. To achieve this goal we firstly recorded the entire daily (24 hours) activity/trip program for each individual and then for each activity performed outside home (even a very short one) we asked detailed questions that allowed us to fully understand the degree of flexibility of each activity. In particular we asked if the individual could have changed departure time earlier or later, have realized the activity in another location, another time of the day, another day or completely cancelled the activity. We also asked whether someone else could have done the activity for her and if she decided herself what time to do the trip. Finally questions related to the frequency of each trip were also asked. Understanding and quantifying these effects is of particular relevance when assessing transport policies to avoid overestimating the demand elasticity in response to crucial intervention such the implementation of congestion pricing schemes.

Our research also contributes to the data collection field. Differently from the majority of the previous studies we used a full efficient stated preference (SP) experiment. Arellana et al. (2012) are the first and the only ones to use an efficient design for departure time studies. But, their design is not fully efficient. They build a two-step optimized design, which breaks the efficiency. The problem is that in the departure time studies, attributes are interdependent and the design attributes presented to the respondents differ from those in the model, by which the design is created (Koster & Tseng, 2009), and this complicated the SP experiment. To solve this problem, in our work we build a customized design pivoted around the preferred arrival for each individual. It is possible to show that this approach is equivalent to the method in which the

design is pivoted around the actual trip reported by the respondent. In short, the difference between the two methods collapses to a constant, which represents the difference (i.e. shift in time) between the preferred arrival time and actual arrival time.

Our SP-design consists of three departure time options (earlier, later and current with respect to the preferred arrival time) and four attributes (departure time, travel time (TT), travel cost and travel time variability (TTV), which is defined as travel time once a week) at five levels each. A second SP was built without TTV in order to measure the effect of not accounting for TTV in the departure time choice. The same individuals answered both SP. The designs have been tested first with simulated data (18 thousand independent observations were generated) and all the coefficients were recuperated at more than 95% of significance. The scheduling model first formulated by Small (1982) and then extended (Noland & Small, 1995) to account for TTV was used.

Initial results show that individuals' rescheduling possibilities are different from what could be revealed from simpler questions as typically asked in the previous literature. We also found that accounting for TTV seems to affect mainly the late schedule delay whose marginal effect with respect to TT and to the early scheduling delay almost doubles.

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