The effect of personal cap-and-trade mileage policies on individual activity-travel patterns

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Abstract
The persistent increase of greenhouse gases (GHG) in the atmosphere is leading to a rise in the temperature of the Earth’s near-surface air and oceans (or Global Warming), contributing to climate changes, extreme weather events and species extinctions. The main greenhouse gas is carbon dioxide (CO2), produced by using fossil fuels for energy and transport. Most national governments have signed and ratified the Kyoto Protocol aimed at reducing greenhouse gas emissions, but there is ongoing political and public debate worldwide regarding what measures to adopt to curb manufacturing-based and personal activity-based carbon emissions. For instance, as a result of the substantial contribution of personal travel activity to GHG emissions, many urban areas in the world are considering stepping up measures to promote more sustainable individual activity-travel patterns by placing implicit restrictions on how much motorists drive. This is in contrast to current transportation emission reduction programs that focus on changing what motorists drive rather than how much they drive. These current programs reward the purchase of fuel efficient and alternative fuel vehicles, but ignore (1) the additional benefits (besides energy conservation and emission reductions) of reducing mileage in terms of congestion reduction, traffic safety, consumer savings and improved mobility for non-drivers, and (2) the additional congestion and accident costs that result when increased fuel efficiency stimulates additional vehicle mileage.

An example of the movement toward promoting sustainable activity-travel patterns in urban areas is the recent exploration by the United Kingdom government to extend the emissions cap-and-trade program, already applied to curb manufacturing-based pollution in the European Union and Japan, to personal carbon emissions. In such a cap-and-trade system, each individual would have a limited amount of fixed credits or a credit “cap” (per month or year) to spend in carbon equivalents of utilities, food, gas, etc. Individuals who fall below their cap by adopting “virtuous” behaviours (limiting the use of private car, eating less meat, recycling etc.) can sell credits to those that exceed their limits. The main concept is of a mandatory policy (for example each individual could be provided with a smart-card to electronically manage her/his own credits), in contrast to a volunteer carbon footprint offsetting program. The research in the field is just now starting to examine the social and economic implications of such a trading program, including the political feasibility of implementing such a program and related equity and effectiveness issues.

In this paper, the focus is on examining the short-term changes in activity-travel behaviour that may be expected when individuals are faced with a cap-and-trade-like program (longer term activity-travel responses such as replacing current vehicles with more fuel efficient vehicles, and changing workplace or home location, are beyond the scope of this study). Specifically, we will discuss an effort to collect data on how individuals would respond in terms of their activity-travel pattern when faced with a mandate to reduce their weekly travel by a certain percentage. This will be based on a two week activity-travel survey called "Activity locator" to be conducted in Cagliari (Italy) in early spring, 2009. A sample of individuals will be provided a GPS integrated smart phone, which will provide geo-coded coordinates of each individual at any point of the week. In addition, the smart phone will also include a "Midlet" system implemented in java language that allows each individual to record (and transmit to
researchers in near-real time) the purpose and the attributes of each activity stop (as in a regular activity diary). In the first week of the two-week survey, each recruited individual will use the device to provide full details of her/his usual activity-travel patterns. In the second week, the individual will be provided a "travel mileage budget" over the entire week that will be a certain percentage (less than 100) of the first week's total travel mileage. As individuals drive in the second week, the device will be programmed to provide the amount of mileage already driven during the week and the remaining travel mileage budget available for the rest of the week. To our knowledge, this is the first such instance of joint GPS and activity data collection to understand how drivers may respond to a "cap" on their travel mileage. We recognize here that the recruited drivers are not likely to be representative of the population; however, the intent is to get objective data to see how drivers, even if not representative of the population, may respond to a travel mileage "cap".

In addition to describing the data collection and processing effort, this paper will also undertake a comprehensive exploratory analysis of the changes in different dimensions of activity-travel behaviour between the first and second week. For instance, individuals may synchronize trips with other household members (sharing a vehicle), may switch to other modes (public transit, bike), may chain activity stops that were unchained earlier, may make fewer out-of-home activity stops, may drive to nearer locations for activity participation, and reschedule activity participations during the week in ways that lead to less travel mileage. We will examine all these changes within the context of the demographic, work, and home/work location attributes of individuals. After the initial exploration of the behavioural shifts, we will then follow up with the formulation of appropriate predictive model structures to estimate the activity-travel pattern shifts due to travel mileage "caps". The authors are well-versed in a number of advanced modelling techniques, which will be brought to bear in this econometric modelling exercise.