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Longitudinal analysis of car ownership and car travel demand in the Paris region using a pseudo-panel data approach

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Abstract

We are interested in this paper to the longitudinal analysis of car ownership (number of cars per household) and car travel demand (the number of trips made by car per household and per day) in the Paris metropolitan area. The aim is to find the determinants of car ownership and use and the longitudinal analysis allow us to determine life-cycle and generation effects. Income and fuel price elasticities of demand for different residential areas and income groups are also determined. A pseudo panel data approach (which consists in grouping individuals or households into cohorts in using repeated cross-sectional data) is adopted using a succession of five large independent surveys (*Enquête Globale Transport*) conducted between 1976 and 2010. The cohorts of households are built from time-invariant variables. Concerning the modelling, we have estimated two models (for car ownership and car travel demand) having a semi-log linear specification. We find an elasticity of income on car ownership of 0.47. The influence of income on car ownership is decreasing with regards to a rise in income and is not significant for high income households. Moreover, the income is not a determinant of car ownership in the most urbanized area while it is positive in car dependent areas. The fuel price elasticity on car travel found is -0.22. Furthermore, the elasticity is more important in dense territories where the households can more easily adapt their behavior to a change in fuel price because alternative modes are available.

1. Introduction

Longitudinal data offer the advantage to distinguish life-cycle and generation effects which is not possible with

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cross sectional data (one period). These data are also useful for long run income or price elasticities. For a longitudinal analysis, two sorts of data are commonly used: true panel data which follow the same individuals over time and time-series aggregate data constituted of relatively large groups of individuals aggregated generally at national or regional level. However these data have some constraints. Panel data are often not available over a long period of time while time-series aggregate data covers long periods of time but lack of individual information. An alternative is to create pseudo panel data constructed from repeated independent cross-sectional data which enable to follow groups of individuals changing over time but sharing time-invariant characteristics.

A longitudinal analysis of car ownership and car travel demand is proposed in the Paris region in order to identify their determinants and to question the 'Peak Car' hypothesis. We investigate in particular the influence of economic and geographical factors as well as the influence of life-cycle and of generations. Furthermore, the objective is to exhibit contrasted reactions of different categories of households over time in determining income and fuel price elasticities of demand distinguishing different residential locations and income groups. This approach enables also to interrogate the hypothesis of the saturation of demand and in particular the possible decoupling of car ownership and use from economic variables (income, fuel price). A pseudo panel data is created in the Paris metropolitan area using the 'Enquête Globale Transport' surveys from 1976 to 2010 to estimate car ownership and car travel demand with a semi-log model. In the next section, a literature review is presented focusing on the 'Peak Car' hypothesis and introducing the construction process of pseudo panel data and the applications in transport field. In section 3, the Parisian context of car ownership and travel is presented. Then, we set out the data and the modelling used in section 4. The estimation results are discussed in section 5.

2. Literature review

2.1. Peak Car

After several decades of car use growth, an inflection of travel behaviour is observed. Car use per head, and sometimes total car traffic, has slowed and tend to reach a threshold at the turn of the 2000s (Millard-Ball and Schipper, 2010; ITF, 2011). This phenomenon is observed in many developed countries at an aggregated level. Goodwin (2012) has expressed the different scenarios for the future of car use and among all the 'Peak Car' which is a hypothesis that the recent change in trend could be the early sign of a sustained decrease of individual car use. Recent research issues have tackled the possible multidimensional causes of this break in trend.

The slowing down of car traffic is influenced by the recent economic slowdown and in particular by the rise in fuel price in the 2000s. Gargett (2012) who has gathered longitudinal data for 25 countries explains this levelling off by real petrol prices and also by fluctuations in the economy and a saturating effect of time. If the response of households to the change in fuel price was generally weak during the period 1970s-1990s, it has tended to strengthen in the 2000s (Litman, 2013). Indeed, the reaction is stronger during a long period of rise (2004-2008) and of volatility (since 2008) (Collet, 2012; Hivert and Madre, 2012).

According to Metz (2010), the saturation of the demand for daily travel is due to the diminishing marginal utility of additional trips which tends to increase a reluctance to travel further. We can also mention the movement of re-densification which contribute to a reduction of car use since in dense areas people can more easily reach their destinations without automobile (Goodwin and Van Dender, 2013; Headicar, 2013; Buehler and Pucher, 2012). In France, politics promoting tramways have contributed to reduce car traffic in many cities in the 2000s (De Solère, 2012).

Another driver is the change in travel behaviour for new generations. Indeed, the percentage of young adults having a driving licence as well as the motorisation has decreased with regards to the previous generations in several developed countries (Sivak and Schoettle, 2012; Kuhnimhof et al., 2012; Delbosc and Currie, 2013).
Newman and Kenworthy (2011) have summarised series of possible causes of saturation: the growth in public transport infrastructures, the improvements in public transport supply or quality of service, the densification of city-centers and suburbs to the detriment of outer-urban areas in several metropolitan areas, the ageing of population in cities, the diffusion of an urban culture and the Marchetti constant (Marchetti, 1994).

In the case of our paper, we are interested in the 'Peak Car' hypothesis from the perspective of the change in trend for the new generations.