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Car use behaviour of Spanish households: Differences for quartile income groups and transport policy implications

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ABSTRACT

The aim of this paper is to estimate fuel demand behaviour related to car use by households with different income levels in Spain using micro-level panel data in order to infer public policy implications. Our results show that the income elasticity of fuel demand is highest for the lowest income group and diminishes monotonically for the others. The price elasticity is highest in absolute value for the lowest income group, lowest for the highest income quartile and similar for the medium-low and medium-high income groups. Finally, the lowest income group is the most responsive to changes in the price of public transport, whereas the medium-low income group is the least responsive. This suggests that pricing policies aiming to reduce car fuel consumption would have different distributive impacts. Thus, the two main pricing transport policies, fuel taxes and public transport subsidies, are deemed complementary and their combination could be defended on distributional grounds.

1. Introduction

The level and trends of fuel consumption in passenger transport and the reliance on fossil fuel energy sources in this sector are a major concern nowadays in many countries, especially due to their contribution to the problems of security of supply and CO2 emissions. Thus, reducing oil consumption in this sector is essential to reduce the associated energy dependence and climate change problems. This is also the case in Spain, whose oil dependence is as high as 99%, and where passenger transport has grown at an average annual rate of 5.3% between 1990 and 2000 and 2.0% between 2000 and 2009 (Spanish Government, 2012), high above the trends observed for the EU-27.[1] The distances have almost doubled between 1990 and 2009, from 192.08 to 390.4 million kilometres/passenger. Passenger cars account for more than ¾ of the increase in overall transport activity in the period (Spanish Government, 2012). Spain is the European country with the most extensive highway network, and has also the largest highway network in per capita terms in Europe. This network has been mostly promoted by government investments (see Albalate et al., 2015 for a description of this process). Imported energy in 2012 amounted to 45,000M€ in Spain, accounting for 86% of the Spanish current account deficit and around 5% of GDP.

Moreover, the urban forms in Spain have been changing in the last twenty years from a monocentric metropolitan model to a sprawl model (Serra et al., 2014). The trends towards suburbanisation and the urban sprawl which emerges in urban spaces have a direct and indirect impact on mobility: People become more car-dependent. This change from a monocentric urban model –typical of European and Asian cities- to a polycentric one –typical of American, Canadian and Australian cities- is observed all over the world (García-Palomares, 2010). Broad differences in mobility patterns can still be observed between the European and American city models (Giuliano and Gillespie, 1997; Giuliano and Narayan, 2003). But there is some degree of convergence from the traditional European urban models to the Anglo-Saxon ones. The aforementioned increase in car use is one of the underlying consequences of the development of the urban sprawl models in Spain. This development has been "particularly convulsive due to its speed and magnitude" García-Palomares (2010, p.197). Therefore, the case of Spain is a good one to analyse passenger transport demand in a context where traditional urban models coexist with

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[1] Total population grew by 19,0% between 1990 and 2009, reaching 46.24 million inhabitants.

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Table 1
Literature survey of works estimating price and income elasticities of automotive fuel demand related to household's income level.

Authors	Period and country	Aim of the study	Results
Archibald and Gillingham (1981)	1972–1973 United States	Estimation of gasoline price and income elasticities at household level from a model estimating: gasoline demand, the demand for miles driven and the demand for fuel efficiency. Price and income elasticities taking into account if there is one or more cars in the household.	Price elasticities Households with one car (−072) Households with more than one car (−0.22). Income Elasticities: 0.29 and 0.55, respectively
Schmalansee and Stocker (1999)	1988 and 1991 United States	Various semiparametric model and non-parametric models to estimate income elasticities of gasoline demand for households below and above 12.000 Euros of annual income, and other demographic characteristic.	For low income households income elasticity is zero. Income elasticity does not fall at high incomes. The income elasticity for the whole population is 0.21.
Kayser (2000)	1981 United States	Joint estimation of gasoline demand and car demand at household level. Gasoline demand is computed as an indirect demand that depends on the households' economic situation (the author uses several control variables)	Income elasticity: 0.48 Price elasticity: −0.23. Differences for control variables; i.e. rural households have higher price elasticities and also households where the spouse works.
Yatchew and No (2001)	October 1994-September 1996 Canada	Estimation of price and income elasticities of gasoline demand.	Income elasticity 0.29 and price elasticity −0.9
West (2004)	1997 United States	Estimation of the demand (miles driven) and vehicle attributes by decile households in order to analyze the impact of taxes on demand for gasoline.	A tax on miles or gasoline is regressive only for upper income groups
West and Williams (2004)	1996–1998 United States	Estimation of an AIDs model with three equations, gasoline, leisure and all other goods by income household quintiles to compute price elasticities, and wage elasticities (proxy of income).Then, they compute equivalent variation to measure the distributional impacts of gasoline taxation.	Gasoline price elasticities range from −0.18 to −0.73 Upper income elasticities are less responsive to gasoline prices than lower income quintiles. Wage (income) elasticities are insensitive for all quintiles.
Wadud et al. (2009)	1984–2003 United States	Estimation of price and income elasticities for different income household quintiles of fuel income demand	Price elasticities follow a U pattern from the lowest to the highest income groups. They range from −0.35 to −0.20. The lowest and highest groups are insensitive to income changes. They range from −0.067 (for the first quintile) to 0.46 (for the second quintile)

new ones more similar to Anglo-Saxon models, which is usually the case in Europe and Asia.[2]

Even if the new and growing form of urban development could have a direct impact on the increase in car use, as it could also be the consequence of the strong policy of investing in motorways, several policies have been proposed to reduce automotive fuel consumption. These policies include fuel taxes, improvements in public transport infrastructures, reductions in the price of public transport and others (for a complete overview, see Gross et al., 2009). While economists generally argue in favour of fuel taxes on the grounds of efficiency and effectiveness (see Basso and Oum, 2007), relatively less attention has been paid to their distributional impacts even if the academic literature on this issue is also abundant.

Most studies on distributional implications highlight the regressivity of price transport policies, namely fuel taxes, due to the allegedly higher average marginal consumption propensity of low income households (Poterba, 1991; Santos and Catchesides, 2004). Likewise, fuel taxes appear regressive in some countries like Chile, Mexico, Costa Rica and Denmark (Agostini and Jiménez, 2015; Anton-Sarabia and Hernández-Trillo, 2014; Blackman et al., 2010; Jacobson et al., 2003). However, Sterner (2012) and Morris and Sterner (2013) conclude that these instruments tend to be proportional when annual expenditure is used as a proxy for permanent income.

This implies that, on average, the share of the tax burden in income is similar for households with different income levels, i.e., the average effective tax rate of the excise duty is very similar for different income groups. This proportionality leads the authors to conclude that, on average, households bear a similar proportion of the economic costs to reduce pollution. Thus, all households do an equivalent economic effort on average to reduce total pollution although this does not imply that this effort is equal in marginal terms.

The literature has traditionally analysed the progressivity of excise duties on fuel with indexes such as those proposed by Kakwani (1977) or Suits (1977). Those indexes measure the average costs of fuel taxes for different income groups, but they are inappropriate to measure the marginal impacts of changes in fuel taxes and public transport policies on fuel consumption, and the associated distributional impacts.

We take a different perspective in this paper in order to discuss the distributional impacts of policies aimed at reducing fuel consumption. The aim of this paper is to estimate fuel demand behaviour related to car use by households with different income levels in Spain, using micro-level panel data for household quartiles between 1998 and 2005. We will measure the response of fuel demand to changes in fuel prices, public transport prices and income both for the whole population and for each income quartile, i.e., low income, medium-low income, medium-high income and high income households. The price elasticities, income elasticities and cross price elasticities obtained will allow us to derive public policy implications, with respect to efficiency and equity.

The analysis of the elasticities of transport demand can substantially contribute to the analysis of the distributional impacts of different policies, since the elasticities allow us to identify the potential reaction of a given income group to key variables (fuel prices and prices of public transport) which, in turn, are affected by those policies. The literature on the estimation of price and income elasticities of fuel demand for different income groups is scarce, in contrast to the literature estimating them for the whole population, which is abundant. Table 1 summarises the

[2] The paper of Hennig et al. (2015) analyses the process of urban sprawl in Europe, highlighting that the Mediterranean coast is one of the European regions, which is highly affected by this phenomenon.

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