

# THE SOCIOECONOMIC DETERMINANTS OF CO<sub>2</sub> EMISSIONS IN THE SPANISH ROAD PASSENGER TRANSPORT SECTOR

Pablo del Río\*

Institute for Public Goods and Policies (IPP)  
Consejo Superior de Investigaciones Científicas (CSIC)  
C/Albasanz, 26-28  
Madrid, 28037 (Spain)  
e-mail: [pablo.delrio@cchs.csic.es](mailto:pablo.delrio@cchs.csic.es)

Desiderio Romero-Jordán  
Universidad Rey Juan Carlos  
Madrid, Spain  
e-mail: [desiderio.romero@urjc.es](mailto:desiderio.romero@urjc.es)

Mercedes Burguillo  
Universidad de Alcalá  
Alcalá de Henares, Spain  
e-mail: [mercedes.burguillo@uah.es](mailto:mercedes.burguillo@uah.es)

## OVERVIEW

The significant increase in passenger transport activity (cars) experienced by Spain and its associated increase in energy consumption have several associated negative aspects, including a greater dependence on foreign energy sources and higher CO<sub>2</sub> emissions. This is a major concern for a country that is far from achieving its Kyoto Protocol commitments and which has a high energy dependency. Nevertheless, cutting emissions in the transport sector is a problem shared by other European and non-European countries. Appropriate policies to curb such emissions need to be based on a careful assessment of the main determinants of those emissions. The aim of this paper is to analyze the determinants of CO<sub>2</sub> emissions in the passenger car road transport sector in Spain with the help of an econometric model. CO<sub>2</sub> emissions per household related to fuel consumption are explained by several price and income variables. We identify the main determinants of those emissions and provide some policy recommendations.

## METHODS

Following the aggregated approach used by Wheaton (1982), Baltagi and Griffin (1983), Johansson and Schipper (1997) and Kharatorodou *et al.* (2009), we specify a model in which the CO<sub>2</sub> emissions per household related to car fuel consumption is the dependent variable and the independent variables are the intensity in the use of private vehicles, fuel prices, household income, the share of fuel expenditures in total expenditures by the household and a set of socioeconomic variables of the households (urban or rural, number of adults etc.).

Four models are estimated. Two of them are cross-section (ordinary least squares and two-stage least squares using instrumental variables) and another two use panel data techniques (fixed-effects and random-effects). We use data from the Continuous Family Budget (quarterly data for the period 1998 to 2005). For this period, a rotating panel is available, including socioeconomic information (such as expenditure on the consumption goods, size of the family, economic status of the breadwinner, etc.) with approximately 3200 households in each quarter.

## RESULTS

The following table illustrates the type of results that we have obtained using the two-stage least square procedure. The results show that most variables are statistically significant. The elasticity of CO<sub>2</sub> emissions to fuel price is -0.6, whereas the elasticity of CO<sub>2</sub> emissions to income and share of fuel expenditure are respectively 1.04 and 0.8. Results also show that the number of adults, rural versus urban, studies of the breadwinner and economic status of the households have a positive effect in car fuel CO<sub>2</sub> emissions in Spain. The results of the other three models are very similar, both regarding statistical and economic significance.

| 2SLS regression                                                        |            |        |       |
|------------------------------------------------------------------------|------------|--------|-------|
| Number of obs                                                          | 14236      |        |       |
| F( 11, 14224)                                                          | 5724,77    |        |       |
| Prob > F                                                               | 0          |        |       |
| R-squared                                                              | 0,968      |        |       |
| Adj R-squared                                                          | 0,968      |        |       |
|                                                                        |            |        |       |
| Ln (CO <sub>2</sub> emissions)                                         | Coef,      | t      | P> t  |
| Ln (price of fuel)                                                     | -0,6210053 | -18,81 | 0     |
| Ln (share of fuel expenditure)                                         | 0,8072576  | 15,96  | 0     |
| Ln (total income)                                                      | 1,045426   | 20,65  | 0     |
| Trend (proxy of intensity in the use of passengers cars)               | 0,0004021  | 27,32  | 0     |
| Ln (Number of adults per household)                                    | 0,4909029  | 42,76  | 0     |
| D1 (Rural households / urban households)                               | 0,0346896  | 3,75   | 0     |
| D2 (Breadwinner is employed / unemployed)                              | 0,000239   | 0,06   | 0,954 |
| D3 (Breadwinner has a university degree / others)                      | -0,0329189 | -2,15  | 0,032 |
| D4 (Households with children / without children)                       | 0,0178752  | 2,06   | 0,04  |
| D5 (Labor indefinite contract / others)                                | 0,0110327  | 0,88   | 0,377 |
| D6 (Households with economic difficulties to buy basic goods/ without) | 0,0232067  | 2,63   | 0,008 |

## CONCLUSIONS

Several policies have been suggested to encourage the technological and behavioural changes leading to a reduction in fuel consumption in transport. Economists have highlighted the role of economic instruments on the grounds of economic efficiency. However, their effectiveness might be limited, especially in the short-term, if the price-elasticity of demand is low and the income-elasticity of demand for transport fuel is high, which is generally the case. Therefore, although necessary, the price signal may be insufficient by itself to induce significant changes in passenger transport demand. This calls for a combination of instruments in order to reduce the “scale effect” of transport (i.e., the level of transport activity).

The results of our estimates suggest that, while fuel pricing policies might have some effects on the CO<sub>2</sub> emissions by households related to private car use, they are only part of the story. The strong income effect indicates that we will need to combine different instruments.