



# The link between urban development and the modal split in commuting: the case of Biscay



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## ABSTRACT

This paper presents an empirical analysis of the links between different land use patterns and the modal split in commuting. The analysis is conducted at municipal level, based on data on land use and mobility characteristics of the de-urbanisation process in Biscay, a small European province, from 1991 to 2001. The links are assessed by means of multiple regression analysis, in which specific techniques of spatial econometrics are applied in order to avoid biased results and unreliable inferences due to spatial dependence. The findings reveal, at municipal level, the importance of gross population density, geographic concentration of the population and, to a lesser extent, the ratio of jobs to residents in explaining the modal split in commuting, and the influence of access to public transport. It is also shown that public transport services have spillover effects that extend beyond the limits of the municipality and encourage use in adjacent areas.

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## 1. Introduction

In cities people are forced to make use of motor vehicles for journeys of all kinds. As a result, impacts associated with motorised mobility such as noise, fumes, accidents, congestion and occupation of space have grown into high-magnitude environmental problems the solving of which must be placed at the core of any pro-sustainability strategy (Camagni et al., 2002b).

Attempts to solve the problem of impacts associated with motorised mobility have traditionally been based on a transport supply approach, in the shape of investments in increasing the capacity and standard of road infrastructures and the quest for technical improvements in vehicles. However, experience has proven that the problem needs to be tackled on various fronts simultaneously. It is necessary not just to improve the range of transportation on offer but also to manage the demand for mobility, so as to limit the need to travel and direct it towards more environmentally friendly modes of transport (EC, 2004). Along these latter lines, a

number of reflections have emerged concerning the need to adopt planning policies that can contain the type of urban expansion characterised by dispersal and monofunctional spaces, which are a breeding ground for increased mobility. A compact, diverse alternative city structure is proposed in which there is easy access to services and to the functions required for day-to-day life (Pouyanne, 2005; Salatino, 2006).

In the past 30 years a great many empirical studies have analysed the links between the characteristics of cities and their models of mobility. The findings of these studies can be consulted in various reviews of the relevant literature (Handy, 1996; Crane, 2000; Litman and Steele, 2013; Ewing and Cervero, 2010). Many of the studies included in these literature reviews are based on geo-referenced (neighbourhoods, municipalities, regions) cross-sectional data; they look at the relationship between land use and mobility via typical regression analysis. However, when it comes to explaining the behaviour of a variable observed at a number of points in space via a set of variables observed at the same points, so-called “spatial effects” frequently appear (heterogeneity and spatial dependence) the consequences of which for the validity of the inferences made in these cases cannot always be dealt with by standard econometrics. Spatial econometrics seeks to resolve the problems caused by the nature of the data used in spatial analysis by explicitly factoring the corresponding spatial dependence structure into models, so that the estimates and inference from the regression model are correct (Anselin, 1988). Spatial econometric techniques are frequently used

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in areas of research such as the analysis of spatial externalities, the expansion of cities and economic growth, but until recently there have been few such studies in the field of mobility (Camagni et al., 2002a,b; Travisi et al., 2010; Moniruzzaman and Páez, 2012; Hong and Shen, 2013; Hong et al., 2013).

The first aim of this paper is to conduct an analysis at municipal level to determine whether land use factors deriving from different types of urban development are linked to the modes of transport for commuting, i.e. to the modal split. Spatial econometric techniques are applied in order to deal with the specific characteristics of geographical data. The second aim is to help extend the use of spatial econometrics to the field of mobility and urban development. Despite the limitations due to using aggregated data instead of household/individual data, the results may provide policy-makers with significant information on the effectiveness of urban planning policies for managing the demand for mobility.

The study area selected is Biscay, one of the three provinces that make up the Autonomous Community of the Basque Country in northern Spain. From the 1970s onwards this area underwent a process of deindustrialisation that culminated in the 1990s with a substantial shift in the basis of its economy towards the service sector and high value-added activities. This new economic situation radically changed its urban dynamics and brought about a process of de-urbanisation involving major domestic migration from former industrial hubs to more rural areas with less public transport. Our objective here is to analyse how this process of de-urbanisation was linked to the mobility pattern that could be observed at the end of the 1990s, which was characterised by the predominance of private cars. We seek to determine whether it would be effective to use urban planning policies as an instrument for managing mobility. We believe that this is an interesting case study because of the speed and extent of the changes that have taken place, and because the study area is a small European province that has not hitherto been analysed in this regard.

The paper is structured as follows: Section 2 outlines the case study selected, describing the urban transformation that took place in the province of Biscay in the 1990s and the nature of the model of mobility in place at the end of the decade. Section 3 explains the database used, describes the variables considered in the econometric analysis performed and presents the methodology applied. Section 4 presents the main findings of the econometric analysis, and Section 5 draws some conclusions from those findings.

**2. Case study: urban transformation and modal split in commuting in Biscay**

According to EUSTAT [“Basque Statistics Institute”], in 2001 Biscay had a population of 1,122,637, spread over an area of 2221 km<sup>2</sup>, divided into 111 municipalities. It is a province of great contrasts, with industrial areas, natural parks, highly-urbanised and markedly rural areas. It is the industrial and financial heart of the Basque Country, Autonomous Community located in northern Spain (see Fig. 1).

Biscay suffered a prolonged period of crisis from the late 1970s to the early 1990s. In the course of that period it switched from its traditional industrial economic base (mining, steel and metallurgy) to a more service-oriented economy. With the onset of that crisis, the structure of dense industrial cities began to change. Jobs and homes began to move out towards more rural areas and new, low-density residential areas arose. This process, known as de-urbanisation or counter-urbanisation, resulted in major demographic changes. A sharp decline of 4.6% in the rural population in the late 1980s was followed by a spectacular 7% increase in the late 1990s. Those who made the domestic migration from the former industrial city centres towards smaller, outlying towns which were rated more highly in environmental terms, were mainly families with children of a medium-to-high socio-economic



Fig. 1. Main roads and cities of Biscay 1:500,000. Source: Basque government.

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