

ASSESSING THE INFLUENCE OF URBAN SPRAWL ON COMMUTING MODE CHOICE

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I. INTRODUCTION

Due to the urban expansion process that has occurred over the last decades in Mediterranean Europe, the urban morphology of their cities has undergone important transformations, with sprawl phenomenon emerging as a central issue, particularly in relation to sustainable territorial planning. Urban sprawl is recognized as a serious urban design problem that leads to the loss of natural spaces. In addition, it involves a high cost in infrastructure and energy, encourages land use segregation, and increases the need for travel, a consequence of which is a greater dependence on private vehicles. All this leads to increased traffic congestion, energy consumption, and pollution (Commission of the European Communities, 2004).

The urban sprawl phenomenon had its boom with the introduction of the car and its massive usage by all social strata. At the same time, there has been a decline in residential density along the periphery of large cities, reflecting changes in market preferences: a large part of the population moving from the central parts to the periphery of cities due to the availability of larger housing size, lower population density, combined with a lack of willingness to pay more to live closer to the workplace. Simultaneously, building and real estate companies have taken advantage of this demand to generate new urban areas (Frumkin, Frank, and Jackson, 2004).

Historically, the growth of cities has mainly been linked to the increase in the urban population. However, in recent decades, despite low demographic growth, several factors have boosted urban growth. The causes that explain the trend of urban expansion are both varied and complex and include the increasing quality and quantity of infrastructures and transport systems, access to private vehicles, lower land prices, lower noise pollution, and new individual preferences to live in single-family homes or changes to family structure with a greater presence of single-person families (European Environment Agency, 2006).

The most controversial impact of the urban sprawl phenomenon is its relationship with the use of specific modes of transport (Travisi, Camagni, and Nijkamp, 2010). The proliferation of low-density urban areas and segregated land usage, coupled with a scarcity of services in proximity, increased distances from the central urban area (Zhao et al., 2010), and private vehicle dependence, reduce the possibility of undertaking active journeys such as walking or cycling (Bahrainy and Khosravi, 2013; Brown et al., 2013; Ewing et al., 2014; Garcia-Palomares, 2010; Jerrett et al., 2013).

Much of the analysis of daily urban mobility has focused on the urban environment, since commuting is considered an indicator of metropolitan area integration. As metropolitan areas expand, daily urban mobility is also diversified through the creation of new places of residence for workers and the different forms of daily mobility these imply.

The objective of this study is to assess, in an empirical way, the influence of urban sprawl on the choice of specific commuter transport modes.

II. METHODOLOGY

This study was carried out in Mairena del Aljarafe, a municipality of 44,388 inhabitants (2015) located in the Seville Metropolitan Area (Spain), which occupies a surface of 17.61km². In its first stage, the municipality of Mairena del Aljarafe was divided into 10 homogeneous areas through a zoning process taking into account urban and spatial factors, highlighting the predominant urban landscape, household typology (apartment building, attached, semi-detached, or single house), construction date, and the presence of infrastructure and services.

Information about usage of commuter transport modes was extracted from the “2015 Commuting, Daily Habits and Urban Health Survey” of Mairena del Aljarafe 2015. To achieve this, a sample of 505 people (16-64 years) representative by age, gender, and geographical area was selected. Personal interviews were conducted in the respective households of those sampled. The four survey interviewers received specific training in order to increase the degree of consistency across the responses.

To assess the sprawl levels of each of the areas, a composite urban sprawl index was created, consisting of six dimensions: population density, net residential density, coverage ratio, land use types, percentage of residential land use, and average year of construction for each of the 10 areas. These indicators were selected based upon availability and adequacy in order to measure and explain the urban sprawl phenomenon. Weights were assigned to each indicator using the Analytic Hierarchy Process (AHP) and the composite sprawl index was calculated using the Choquet Integral as an aggregator.

To verify the possible relationship between urban sprawl and use of specific transport modes, the PLUM regression model was utilised as it is suitable for ordinal categorical variables. The analysis of Multinomial Logistic Regression used in most studies on this topic (Ewing and Cervero, 2001; Ewing, Handy et al., 2006, Ewing, Schmid et al., 2008; Ewing, Meakins et al., 2014) introduce the variables one by one, while checking the effect of each independent variable entered into the explained variable. However, in order to study the influence of urban sprawl on the probability of using a particular transport mode, Ordinary Regression (PLUM) has been used through the SPSS statistical package to preserve the information contained in the ordinal nature of variables.

III. RESULTS

The interviewed population, aged between 16 and 64 years, consisted of mostly active workers residing in single-family dwellings; a high proportion had university level education and owned a private motor vehicle (car and/or motorbike).

In order to assess commuting patterns in each of the established areas, the transport modes were grouped into private motor vehicles (car and/or motorbike), active transport (walking and/or cycling), and public transport (bus and/or underground).

The percentage of the population that uses private motor vehicles for commuting was higher in more sprawling areas while that using active transport was greater in less sprawling areas. Likewise, it can be seen that in areas with greater sprawl levels the use of public transport is insignificant or even non-existent. It should be noted that the population living in areas with lower sprawl level undertake more active commuting compared to those in more sprawling areas.

It is verified that in all cases the expected values are quite similar to the observed values when relating transport mode choice with urban sprawl levels. Therefore, we can affirm that the model created accurately predicts the choice of transport mode used for the population according to the sprawl level of the area of residence.

IV. DISCUSSION AND CONCLUSION

The use of particular transport modes depends upon many factors, but the probability of using one transport mode or another is in part associated with the sprawl level. Other published studies, mostly in the Anglo-Saxon region, have investigated the relationship between sprawl and the use of transport modes, albeit using the metropolitan scale as a spatial ambit of study. It is necessary to extend the discussion on urban sprawl effects to other scales of greater detail, such as sub-municipal. It is precisely in this research that the relationship between the degree of urban sprawl and transport mode for commuting has been empirically demonstrated at sub-municipal scale. This scale of detail allows a greater rigor and precision than the studies carried out on the metropolitan scale or even at municipal level. In addition, a large number of spatial variables have been used in this study to establish a composite index that takes various geographic factors into account.

Statistical analysis using the PLUM ordinal regression model has shown that there is an association between sprawl levels and use of specific transport modes. The observed values

are quite similar to the expected values and it can be seen that the model perfectly predicts the probability of using specific transport modes depending upon the sprawl level. Therefore, people living in more sprawling areas are more likely to use private motor vehicles for commuting and less likely to use active transport related to physical activity (cycling, walking), compared to those residing in more compact areas.

Active commuting related to physical activity, such as walking or cycling, is considered a sustainable solution to many public health and transportation problems (Badland, Schofield, and Garrett, 2008). This research corroborates that urban sprawl is a determining factor in the use of transport related to physical activity, not only within the Anglo-Saxon population, but it also conditions the choice of specific transport mode of populations living in the Mediterranean context.

The results of the present study are consistent with those derived from previous studies described in the scientific literature. This research has demonstrated that urban sprawl conditions the choice of transport mode when commuting, affecting different facets of the life of the population, and creating a significant impact on the environment. We demonstrated how people living in urban areas that are more sprawling are more likely to use private motor vehicles than those who live in less sprawling areas.

Urban development policies should encourage the development of more compact urban areas, supporting the use of more sustainable transport modes. From the urban planning point of view, it is necessary to organise the expansion of cities, promoting the mixed uses and service proximity as a base of accessibility. From the mobility perspective, it is necessary to reduce private vehicle dependence, increase active commuting, and transform built environments into more convivial places for meeting and sharing life moments.