

Accessibility and Local Development

Interaction between Cross-border Accessibility and Local Development in Portugal and Spain

**Maria J. FONTES¹; Anabela RIBEIRO²; Matias MAYOR³; Jorge
SILVA⁴**

¹Department of Civil Engineering, ISEL
Rua Conselheiro Emídio Navarro, 1, 1959-007 Lisboa, Portugal
+ 351.218.317002, mjfontes@dec.isel.ipl.pt

²Department of Civil Engineering, FCTUC
Pólo II, Pinhal de Marrocos, 3030-390 Coimbra, Portugal
+ 351.239.797107, anabela@dec.uc.pt

³Departamento de Economía Aplicada, Universidad de Oviedo
Avda. Del Cristo s/n, 33006 Oviedo, Spain
+349.851.05051, mmayorf@uniovi.es

⁴Aerospace Sciences Department, UBI
Edifício II das Engenharias, 6200-358 Covilhã, Portugal
+ 351.275.329732, jmiguel@ubi.pt

Keywords: Accessibility, development, cross-border, GIS, spatial econometrics

Introduction

The main objective in this work is to understand road infrastructure's impact on development, especially in the EU-context and in the border areas between Portugal and Spain. In these areas, a new road infrastructure was built in the last decades, changing completely the accessibility panorama, while the development variables seem to get worst in most of the cross border regions. Some links are still missing, but some already exist and are not having the expected development impact. The analysis is to be done at the municipality level in order to evaluate the regional differences within the cross border area, which is not possible at the higher NUTIII level.

Considerable research exists for road infrastructure's impact on development but not at a municipality level ([1], [2], [3], [4], [5]). Research on specific cross border issues is just now starting to appear ([6], [7]). Some studies using the municipal level also appeared lately ([8], [9]).

This is also one of the issues where endogeneity still remains a problem for analysis such as regression one. Another central constraint is the fact that it is difficult to obtain relevant data from both sides of the border and to compare them between municipalities in Portugal and Spain. Therefore, the central aim of this work is to analyze, at a municipal level, the road infrastructure's impact on development in the Portuguese-Spanish Cross Border areas, using all the relevant variables, including accessibility, and accounting for problems such as endogeneity. The first important step now being developed is the construction of a Cross-Border Data Base.

The Problem

In a first glance, is important to clarify why this is a problem.

The implementation of the main road transport infrastructures in Europe is based on the EU TEN-T (Trans-European Transport Networks). As mentioned in the EU site for Transport and Mobility, “Transport infrastructure is fundamental for the smooth operation of the internal market, for the mobility of persons and goods and for the economic, social and territorial cohesion of the European Union” ([10], [11]). The implementation of this infrastructure in Portugal followed the European guidelines, and some regional development improvements were expected, namely in Portuguese off-cost regions, close to Spain and traditionally less developed. This development did not happen with the magnitude and extension expected, while these regions loose competitiveness and population.

The instruments used by Portuguese Government such as the National Road Plan for 2000 (PRN2000) ([12]), although containing some general principles and guidelines, are not clear on the real orientation towards the relation between road planning and regional development. Other planning instruments such as the PNPT (the main National Planning Instrument) ([13]) also present some strategic orientations for regions and sub-regions and express the need for specific programs for Cross-Border Cooperation. The same type of instruments and orientations occurs from the Spanish side, not differing in scope and both (Portuguese and Spanish) referring the need to develop the cross-border areas which are generally less developed. Portugal remains one of the least developed countries in Europe, both in social and economic areas, with low profile literacy levels and with the circumstance of having completely different rhythms in the coastal (core) and the inner (peripheral) regions.

In Figure 1 it is possible to observe the population variation in Portugal and Spain between 1991 and 2001. In both countries, some of the regions where these variations are smaller or negative (in blue) are coincident i.e. are mainly in the cross border areas.

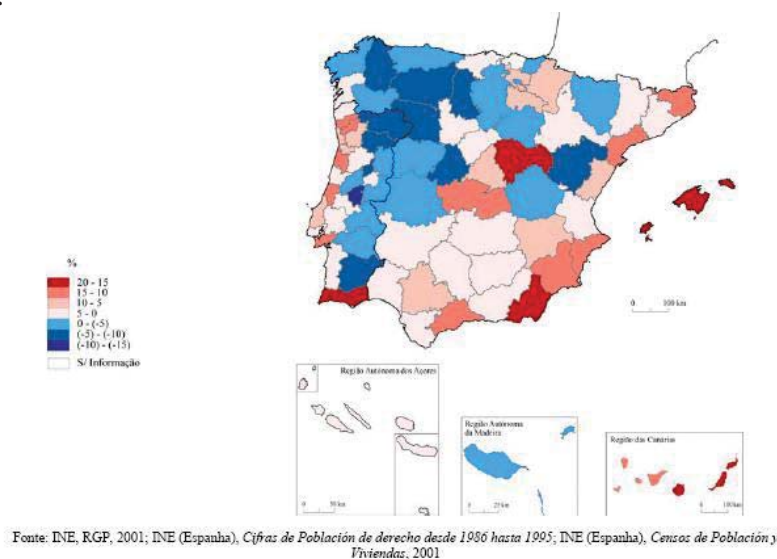


Figure 1: Population evolution between 1991-2001 at NUT III level. Source: INE Portugal and INE Spain

In the case of Portugal, this map clarifies the differences between coastal and inner regions rhythms. In the case of Spain it clarifies the differences between the East and the West and between the South and the North.

Specific programs like INTERREG are focused on solving development issues in these areas. In fact, and in Figure 2 it is possible to see the above mentioned Cross-Border area between Portugal and Spain, especially in the North-Center part. This is one of the key areas in the European Union that needs specific policies, in general materialized in cooperation projects between the two countries.

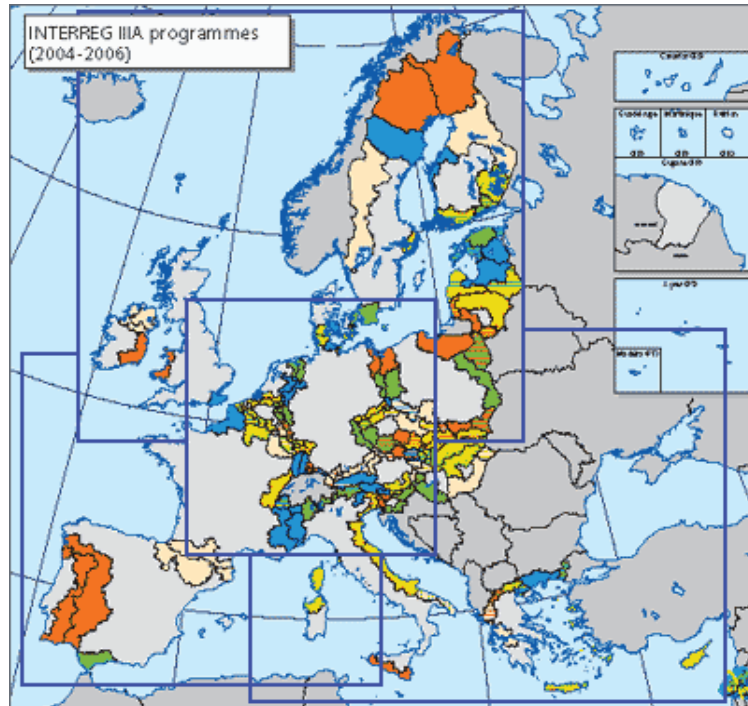


Figure 2: INTERREG III main action areas (Source: <http://ec.europa.eu>)

The Operational Program for Cross-Border Cooperation between Portugal and Spain, 2007-2013, aims at the development of border areas between the two countries, enhancing economic relations and networks of cooperation between the five areas defined in the program, which includes a set of 17 NUTS III border areas and four priority areas of intervention. One is the cooperation and joint management in spatial planning and accessibility.

Finally, in Figure 3, and looking at the cross border area on the center north of Portugal, it is possible to observe the new main roads infrastructures network that were built since the beginning of the 90's, and the population evolution between 1991-2001, but now at the municipality level.



Figure 3: Portugal north-center cross border region population evolution and main road network (Source: [9])

Observing the problem with this geographical detail, some regional differences start to come up and the analysis of the main problem (that is road infrastructure's impact on development in cross border areas) becomes more effective and clear. In a quick glance, new infrastructures seemed to have some impact on population in cross border areas, but only for a couple of municipalities.

Study area

One big challenge yet to be done is to have a joint data base, for the analysis of impacts and the forecast of scenarios in the cross border area. This work is based on the INTERREG definition of the cross-border one between Portugal and Spain (see Figure 4)



Figure 4: Portugal north-center cross border region. Source: http://ec.europa.eu/regional_policy/country/

In Table 1 it is possible to see the correspondence between NUT III and NUT II in both countries.

Table 1: NUT II and NUT III cross- border Portugal and Spain

PORTUGAL		ESPAÑA	
NUT II	NUT III	NUT III	NUT II
NORTE	Minho - Lima Cávado Trás-os-Montes Douro	Pontevedra Orense	GALIZA
CENTRO	Beira Interior Norte Beira Interior Sul	Zamora Salamanca	CASTELA e LEÃO
ALENTEJO	Alto Alentejo Alentejo Central Baixo Alentejo	Cáceres Badajoz	EXTREMADURA
ALGARVE	Algarve	Huelva	ANDALUZIA

These geographical units form the cross-border region but the level of analysis is at the municipal level.

Using this area as the starting point for analysis, a new database with the municipalities is to be built, considering the existence of a geographically variable analysis of common and uncommon areas treated with the use of Geographic Information Systems (GIS).

The GIS contribution comes from its main feature which is the ability to develop several spatial analysis functions, because in addition interconnects and overlaps the attributes of these data, resulting in the creation of new maps. In these maps the reference values for each position act as independent values associated with the position on several maps. This addition is very important in this case, and gives us the ability to create homogeneous zones on both sides of the border. This scenario will be supported by selecting a set of variables that will define more clearly which are the geographical units to be chosen.

In Figure 5 it is possible to observe an extract of the under-construction layout of GIS, and the different size of Portuguese and Spanish cross-border regions.

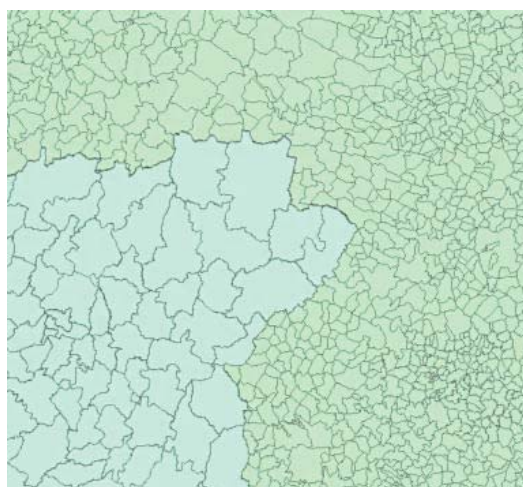


Figure 5: Portugal north-center cross border region

Based on variables needed for the analysis and available for the municipal level, the step being developed is to built some new geographical areas in both sides of the border, comparable in size and characteristics, and that can be easily related with the road network.

Analysis

After the definition of the cross-border area a spatial econometric analysis ([14]) will be performed, making use of specific software with geographic interfaces. Such software allows a friendly graphical interface for better visualization of the result of geographical statistics for autocorrelation and other territorial indicators.

That is, the purpose of this study is then to assess the impact of National Road Plans of both countries in cross-border development using the defined cross-border area.

The main relation under analysis is of the following form:

Development = f [Accessibility; Socio-economic variables]

Where development (GDP per capita or Population growth) is consider to be dependent of accessibility (measured as relative and/or potential accessibility in travel time between points - main cities in each municipality) and of other population and economy variables such as literacy, employment, sectors of activity, buildings licensed, number of firms, among others.

The final aim is to check if accessibility is a determinant variable in development and what are the regional differences in this impact, using spatial correlation.

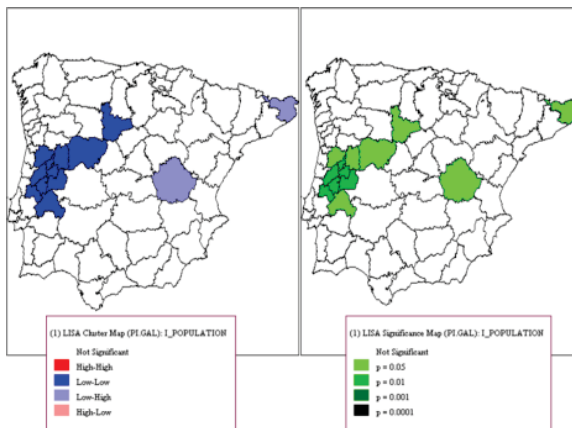
Results and Discussion

A first exploratory analysis is also being developed, first at the NUT III level and combining data from Portugal and Spain, in order to have a first general idea of the Cross Border Region behavior.

Thus a first step is the development of autocorrelation exploratory studies, LISA maps and significance maps.

These spatial autocorrelation studies were taken in the following variables: population, GDP and households. The area used is the Iberian Peninsula and NUTIII in the geographical unit (more aggregated than the municipalities to be developed further).

Population:



The NUTIII identified within the group ‘low-low’ (in dark blue), are all contiguous and locate in both sides of the border. From the Portuguese side 9 NUTIII are included, and from the Spanish one 2 NUTIII are included. This is an area where, in the Iberian Peninsula context, it is quite significant (statistically) low population values

and correlated with population ones in the neighbors.

Figure 6: LISA and Significance maps for Population variation 1991-2001

GDP and Households:

Although similar to the ‘less’ population clusters, both the ‘households’ and the ‘GDP’ variables form a more defined cluster, with a set of contiguous municipalities in the ‘Iberian Raia’.

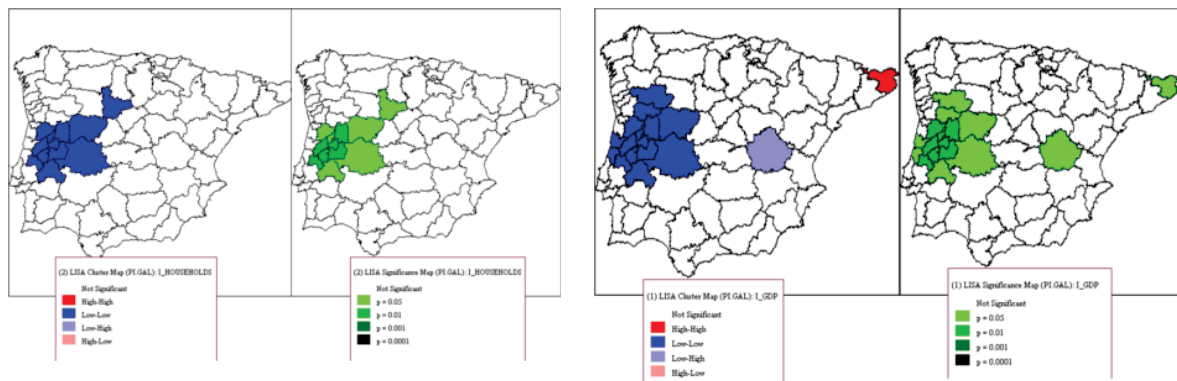


Figure 7: LISA and Significance maps for GDP and Households variation 1991-2001

From this simple analysis it is possible to conclude that this cross-border area is a particular sensitive case study for both countries. The selection of variables should take this previous study into account.

The spatial regressions that are built using data from these areas might as well reveal some causality and nonlinear problems, to be modeled. In fact, because these zones appeared as distinct in the context of the Iberian Peninsula this might mean that there are unknown relationships characterized by complex local nonlinear patterns.

Conclusions

This work’s main objective is to build a model able to measure the relationship between accessibility and development for a set of municipalities in the Portugal/Spain cross-border area. This scientific opportunity stems from the observation of huge road infrastructure investment, often indicated as being little in line with the local development needs in peripheral regions that are currently facing sharp population decline and weak business dynamics.

At the same time, and since this subject is of so much importance, it is surprising that very few studies have focused on quantitatively measuring the complex relationship between accessibility and development, as a tool to adapt and adjust the system to local needs of development.

This study has selected the particular case of cross-border regions, since these are usually the most depressed areas in both countries. This is an ongoing study. A first important step is the definition of the cross-border area. A second step is the definition of the variables and a third step is the development of some autocorrelation studies acting as exploratory studies. After the accomplishment of these 3 steps the spatial regression analysis will be developed.

References

- [1] **Aschauer, D. A.** (1989), Is public expenditure productive?. *Journal of Monetary Economics*, Vol. 23, 1989, pp. 177-200.
- [2] **Rietveld, P. and Bruinsma, F.** (1998), *Is Transport Infrastructure Effective? Transport Infrastructure and Accessibility: Impacts on the Space Economy*. Springer -Verlag, 1998, Berlin.
- [3] **Gutiérrez, J. and Urbano, J.** (1996), Accessibility in the European Union: The Impact of the Trans-European Road Network. *Journal of Transport Geography*, Vol. 4, pp. 15-25.
- [4] **López, E., Gutiérrez, J and Gómez, G.** (2008), Measuring regional cohesion effects of large-scale transport infrastructure investments: an accessibility approach. *European Studies*, Vol. 16(2), pp.277-301.
- [5] **Páez, A.** (2004), Network Accessibility and the Spatial Distribution of Economic Activity in Eastern Asia, *Urban Studies*, Vol. 41(11), pp. 2211-2230.
- [6] **Johnson, C. M.** (2009), Cross-Border regions and territorial Restructuring in Central Europe for More Cross-border Space. *European Urban and Regional Studies*, Vol. 16(2), pp. 177-191.
- [7] **Lopez, E., Monzon, A., Ortega, E and Quintana, S.M.** (2009), Assessment of Cross-Border Spillover Effects of National Transport Infrastructure Plans: An Accessibility Approach, *Transport Reviews*, Vol. 29(4), pp. 515-536.
- [8] **Ribeiro, A.** (2009), *As infra-estruturas rodoviárias e o desenvolvimento regional*. Tese de Doutoramento em Ordenamento do Território e Transportes, faculdade de Ciências e Tecnologia da Universidade de Coimbra. Coimbra (PhD Thesis).
- [9] **Ribeiro, A., Antunes, A. , and Páez, A.** (2010), Road accessibility and cohesion in lagging regions: Empirical evidence from Portugal based on spatial econometrics model. *Journal of Transport Geography*, Vol. 18, Issue 1, pp. 125-132.
- [10] **European Commission** (2011) TEN-T Transport infrastructure. http://ec.europa.eu/transport/infrastructure/index_en.htm. Accessed 29 June, 2011.
- [11] **QCA III**, Programa de Acessibilidades e Transportes (POAT), Objectivos, 2010.
- [12] **INIR** – Instituto de Infra-Estruturas Rodoviárias IP, Objectivos, 2010.
- [13] **Programa Nacional da Política de Ordenamento do Território (PNPOT)**, Programa de Acção, cap.1, Orientações gerais, pp. 5.
- [14] **Anselin, L.** (1988), *Spatial Econometrics: Methods and Models*. Kluwer Academic Publishers, Dordrecht.