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Discussing the spatial dependence and the determinants of the municipal expenses of Portuguese forest sappers' teams

Paulo Reis Mourao [1]

Department of Economics, Economics & Management School, University of Minho, 4700, Braga, Portugal

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ABSTRACT

The costs of forest sappers' teams are discussed in this work, using the present Portuguese model as a case study. The teams' actions and expenses between 2000 and 2015 have been observed, and several hypotheses for the distribution of the shares of municipal expenditures on these brigades are discussed. Using spatial autocorrelation models, spatial autoregressive models, spatial Durbin models, and spatial error models, several original results have been achieved. A positive spatial autocorrelation in the shares of these municipal expenditures has been observed for the first time in the literature, revealing a mimetic approach among Portuguese municipalities that implies the need for re-arranging the current programs and regulations related to forest sappers' teams towards an enlarged space of action.

Introduction

Forest sappers' teams are important players in forest firefighting. The forest sappers of these teams are paid workers with an adequate profile for forest firefighting, communicating with rural/forest players, and helping with recovery plans for damaged areas. In Portugal, after a boom in the number of brigades in the early years of the 21st century, there is currently a stabilization of these values, although a slight downtrend has been identified in the most recent years.

The noun 'sapper' has three major senses in the Portuguese language ("sapador"). The most common sense is the one used here – the sense of forest sapper, i.e., of a professional able to fight forest fires and to assist in efforts of forestry (and the damaged forest sectors') recovery. Several legislative documents (further commented) have provided a more expansive definition to describe the reality of Portuguese (forest) sappers' work. Besides the sense of forest sappers, there is still a sense of (urban) sappers, professional firefighters majorly operating in urban scenarios, and of (military) sappers, military troops prepared with civil engineering training.

Usually, a Portuguese forest sapper team (with a minimum number of five hired sappers) has the following functions, regulated by Decree-Law 109/2009: preventive actions of forestry, firefighting, support of post-fire activities, check-ups of controlled forest fires, public information, and training of people who work with or live in forest areas. The dynamics regarding the creation and extinction of forest sapper teams can be consulted in the official source of the Portuguese Institute for the Conservation of Nature and Forest (ICNF): http://www.icnf.pt/portal/florestas/dfci/sf1/psf/esf

Forest sappers are paid workers, different from volunteer firefighters (who make up many bodies of firefighters across Portugal). Therefore, groups of forest sappers are generally created by municipalities, groups/associations of municipalities, and associations of people related to the forest sector interested in developing additional strategies for fighting forest fires and minimizing the extent of forest fire damage (Decree-Law 109/2009). The process of creation of groups of forest sappers is regulated by a proper set of legislative documents (Decree-Law 109/2009 and subsequent regulations).

There is a significant correlation between sapper teams' expenses in each municipality and the distribution of these teams across the country (Table A1, in Appendix). Therefore, it would be expected that areas with more forestry production would assume higher expenses or that areas most affected by forest fires would realize the relevance of these teams. However, when observing the distribution of these teams across the Portuguese municipalities, the relevance of forest sappers' teams for each municipality (measured by the share of municipal expenditures) is not only explained

E-mail address: paulom@eeg.uminho.pt
[1] (http://www1.eeg.uminho.pt/economia/paulom/)

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by these conventional hypotheses. Therefore, it is here hypothesized that municipalities tend to replicate the profile of expenses on forest sappers observed for the neighbouring areas.

There are various possible reasons for this explanation, all of which will be explored in this work. Close municipalities share common resources (like forestry spaces), which partially explains the similarity of municipalities' expenses on forest sappers. Close municipalities tend to assume similar patterns of municipal expenditures due to the pressures of centralized funding, as well as close compositions of outlays as a risk-aversion strategy. These hypotheses will be discussed and tested in this work.

The remaining sections of this paper are as follows: Section 2 reviews the literature, the numbers of Portuguese teams of forest sappers, and discusses the related explanations. Section 3 exhibits the empirical section of this work, detailing the data sources, the descriptive statistics, and the spatially-related regressions: SAR (spatial autoregressive model), SAC (spatial autocorrelation model), SEM (spatial error model), SDM (spatial Durbin model), and spatially mixed models. Section 4 concludes the paper, reveals potential political implications, and further challenges.

Forest sapper funding – a review of the literature

Costs and numbers in Portugal

The costs of the forest sappers' teams can be divided in direct costs, which are directly related to the essential functions of these teams, and indirect costs, which are associated with the regulations concerning these groups and activities (Hur et al., 2013). Examples of direct costs include wages, cars, gas, personal protective equipment, auxiliary machinery, and supplies, while examples of indirect costs are the expenses on repairs for cars and machinery, depreciation of assets, insurance premiums, or costs on consultancy activities.

The funding of the expenses associated with forest sappers[3] – namely, wages and operational costs – is mostly attributed to public funding or transfers, usually from one or more of three sources: municipal grants, transfers from the Institute for the Conservation of Nature and Forest (ICNF), or support from special governmental frameworks and forestry funds.[4] Such costs also come out of some revenues made available by the hiring municipalities and forest associations. There have been recent dissensions about the distribution of this support among the various entities involved (Observador, 2016).

For European approaches on the evaluation of forest sappers' costs and added value, the works of Xavier Viegas et al. (1999), Krasovskii et al. (2016), or the European Forest Institute (2004) offer a wealth of information. In Portugal, the evolution of forest sappers is particularly documented in works like Baptista (1993) or Mendes (2007). Starting from 18 teams of men and women formed by the National Program of Forest Sappers in 1999, the most recent numbers suggest the existence of 283 forest sappers distributed by 63% of Portuguese municipalities (ICNF, 2012; Rainha, 2013; Vilhena, 2014). After a boom immediately following the appearance of the related legislation about sappers (1999–2000), a significant number of these teams disappeared, mostly between 2004 and 2005, and especially in the following administrative districts: Castelo Branco, Guarda, Vila Real, and Viseu, the lattermost of which represented two thirds of the disappearing teams. A 2014 report still denounces the decrease of 75 forest sappers between 2013 and 2014 across Portugal (INE, 2014). The next figure (Fig. 1) shows the distribution of forest sappers' teams in Portugal in the year 2012 (ICNF, 2012).

Most of the teams of forest sappers are located in the north and center of Portugal, in a kind of 'corridor' located in the inner areas of the country. It also seems that areas with more teams are surrounded by regions with a considerable density of forest sappers' teams, indicating a possible positive spatial interdependence. Further tests of this hypothesis will be discussed later in this work.

The dynamics of forest sappers: conventional explanations and three challenging hypotheses

From the previous sub-section, it becomes clear that the presence of the groups of forest sappers is not randomly distributed across Portuguese municipalities. Therefore, it is our major intention to investigate this distribution and to test hypotheses for it.

The conventional explanations

As previously discussed, forest sappers are professionals focused on fighting forest fires. Therefore, when discussing the forest sappers' distribution across a space, the distribution of some dimensions already identified and tested in the literature must be considered.

The first dimension is the distribution of forest fires. The researchers expect a positive correlation between past incidents of forest fires in a given place and the presence of denser teams of forest sappers (Borges and Uva, 2006; Rebelo, 2003).

The second dimension emphasizes the gravity of forest fires' occurrence. The number of forest fires and the degree and amount of burnt forest area in a given location are often quite different. Usually, there are higher numbers of forest fires without expressive burnt areas in coastal areas or in more urbanized regions (Cravidão, 1990). In return, more rural areas in the inner regions of a country tend to have larger amounts of burnt area per fire (Mourao and Martinho, 2014). Consequentially, the development of forest sapper teams can also be explained by the evolution of burnt areas along a period and/or across an area (Mendes, 2007; Sahin and Ince, 2009).

However, the creation and development of forest sappers have not only been associated with reactive policies (Mourao and Martinho, 2016). In this work, three additional hypotheses are discussed regarding the appearance of forest sappers' teams due to the active role of public and private agents. The hypotheses include redistribution intentions, the action of local associations, and the mimesis of the dynamics of neighbouring areas.

Redistribution intentions: the role of the public initiative

The less dense areas of the inner regions of Portugal are well-known for facing several economic challenges. Their economic dynamic is not sufficient to attract considerable private investment or, consequentially, to create jobs (Sciulli et al., 2012). Therefore, some of the initiatives of public agents have been implemented in an attempt to counter-balance this apathy from private agents. Mourao (2005) has shown that Portuguese municipalities try to minimize unemployment effects by generating job opportunities when the municipalities' unemployment rates increase. The Portuguese Municipalities try to do this by creating municipal jobs, some of them related to forest areas. Additionally, centralized public figures have also been responsible for some initiatives pertaining to the creation of programs for public employment.

[3] Check the following legislation packages: Circular 163/2005, Order 4208/2013, and Circular 104/2013. The two latter documents are particularly interesting for evaluating the financial contingency of many of the hiring entities of forest sappers' teams because these documents allow the waiver of banks guarantees from the hiring entities of sappers' teams' for receiving financial grants from the Ministry of Agriculture.

[4] Mendes (2007) suggests that these transfers to forest sappers valued around one half of all the values transferred by the Ministry of Home Affairs to the issue of forest fire prevention.