PAPER

Title: Spatial Distribution of Hazardous Pollutants: Environmental Justice in Spain

Authors and e-mails of them: Marta R. Casanova (marta.roig-casanova@uv.es), Marina Múñoz

Department: Economía Aplicada

University: Universitat de València

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Abstract: *(maximum 300 words)*

The spatial distribution of pollution can be a product of chance or, on the contrary, can be driven by forces hard to identify. These forces may create diverse patterns in the distribution of pollution, in which minorities or deprived groups are systematically overexposed to its negative effects. Thus, to check this phenomenon, this work empirically assesses the state of environmental justice in Spain by the analysis of differences in the socioeconomic composition of Spanish municipalities with and without pollution. Since this is still a developing field, there is scarce literature we can refer to, especially in Spain. Therefore, we hope that this research contributes to creating a public debate that gives relevance to the environmental justice concept. We consider as pollutants hazardous and non-hazardous off-site waste transfers, that are included in The European Pollutant Release and Transfer Register (*E-PRTR*). We used qGIS and Stata software to process both the pollution and socioeconomic data. Firstly, we used qGIS to create maps to easily observe the distribution of polluting points. Secondly, we used Stata to run a tobit model that allows us to address the impact of the socioeconomic variables considered in the quantity of pollution (in tons) of each

municipality. Considering the complexity and lack of standardized tools in this field, we have drawn some conclusions. In the first place, we observe a positive correlation between both the income level and the percentage of non-EU immigrants and the quantity of pollution, and secondly, differences in the quantity of pollution amongst Autonomous Communities are statistically significant for most of them.

Keywords: *hazardous pollutants, environmental justice, social awareness, spatial analysis*

1. Introduction

The concept of “environmental justice” (EJ) was born in the United States (US) around 1987. It focuses on the overexposure of deprived people and minorities to a variety of environmental hazards, such as toxic waste, chemicals, and unsafe workplaces, among others (Landrigan et al., 2010; Moreno-Jiménez, 2010). Since it started, this study field has been constantly evolving and becoming increasingly complex (Walker, 2012). This might be due to the challenges that hinder the EJ assessment. There are three major problems.

Firstly, the lack of a common and validated theoretical approach amongst all scholars. Secondly, the need for standardized methodological tools for an empirical EJ evaluation applicable in a wide range of location and contexts. And thirdly, since the main goal of these works is to identify these population groups to improve their living standards, there is an especial need for increasing the public awareness and enhancing the decision-making processes, either through the implementation of public policies with an EJ perspective (Hervé Espejo, 2010), through collective action (Nweke and Lee, 2011), or both.

Until now, most of the existing literature has referred to the socio-spatial distribution of environmental hazards, focusing mainly on variables accounting for income, race/ethnicity, gender and education[1]. Although we can find plenty of empirical studies in the US, there is an evident lack of literature in Europe, and specially in Spain (Germani et al., 2014; Padilla et al., 2014), where we have only found one case study analyzing the EJ state in Madrid and Barcelona (Moreno-Jiménez et al., 2016). Thus, this work aims to empirically assess how the hazardous pollutants are distributed and if there is a pattern between them and the population

[1] For example, see Brainard et al., 2002; Moreno-Jiménez et al., 2016; Germani et al.,2014; Padilla et al., 2014; Anderton et al., 1994; Viel et al., 2010; Jerret et al, 2004).

that is more likely to suffer the consequences of developing their everyday life in a polluted environment. One interesting result of our study is that the percentage of immigrants coming from a non-EU country is statistically significant and is positively related to the tons of pollution emitted. This makes us think that there could be some kind of environmental injustice, meaning that being an immigrant from a non-EU country increases the odds of living in a more polluted municipality. Although we won't try to establish a causal relationship, this result tells us that it would not be surprising to find one.

This work is organized as follows. Section 2 is divided into two subsections: the first one is a comprehensive theoretical analysis of the EJ concept, to establish a clear framework before starting our own empirical analysis. We pay special attention to the difference between the US and the European approaches and to the theoretical evolution of the EJ paradigm in academia. The second subsection is a review of the existing literature, beginning with the first most relevant studies that were made in the US, following with closer and more recent works which we have used as a reference. In section 3, we describe the four databases we used to gather the necessary information to make our own case study for Spain. We used qGIS software to visually show in a map the distribution of polluting points in both Europe and Spain. In those maps, we created a scale color label to help us identify points where the quantity of waste emitted is higher. Following this, a descriptive analysis of chosen variables is made is in section 4, with the later description and interpretation of the results of the tobit model we run in Stata. Finally, in section 5, we draw our conclusions and set our goals for further research in this field.

2. Theoretical framework

2.1 Background: the concept of "environmental justice"

The environmental issues and their social consequences began to be relevant to the public about 175 years ago. Concerns about environmental hazards started around 1820 due, among other things, to the rapid industrialization and the environmental damage that it entails. Since that moment there has been some progress in the implication of different social and academic groups in the fight against the harmful effects of segregation and environmental inequality. Despite this, it has taken a long time until the most harmed collective —black people and other immigrant minorities— could protest and be listened to (Laurent, 2011).

Concretely, the notion of *environmental justice* as we know it now was born in the US. The first time that a minority mobilized against their disproportionate exposure to the environmental

hazards was in Memphis, Tennessee. In the 1960s, Dr. Martin Luther King led a march to improve the working conditions of garbage workers. These workers had to face unfair wages for their work and were mistreated by the owners of the sanitary companies that were harming the environment. Their lives were put at risk and they didn't have any access to education, which made it impossible for them to progress and have the necessary resources to fight against this unjust treatment. Although this event was relevant for the cause and had some impact, the demonstrations of the Warren County (North Carolina) in the mid-1980s have been the ones identified as the beginning of the environmental justice movement by most of the researchers (Silveira, 2004; Laurent, 2011).

These movements emerged due to the overexposure to the harmful consequences of hazardous pollutants and toxic waste that the immigrant minorities were suffering, and their consequent discrimination (Laurent, 2011). More specifically, the aim of these protests was to fight against the building of a toxic waste dump near their residence zone. After this, social researchers began to pay special attention to the "environmental racism" that was taking place in that county. The unequal treatment of this community triggered investigations such as the publication of a United Church of Christ report in 1987 named *Toxic Wastes and Race in the United States* (Commission for Racial Justice, 1987; Bullard, 2008). Since this episode, the environmental justice debate and relevance has grown and has been included in an increasing number of public policies, hence getting closer to a more complete and inclusive approach to tackle the prejudices of the environmental injustices (Laurent, 2011).

As we mentioned before, this field started growing first in the US and then in Europe and other places around the world (Lee, 2002; Laurian, 2008). There are two main differences between the US and the European approach. Firstly, not only because of how it was born but also because of the conditions of the country, the study of the environmental justice in the US has been linked especially to racial and ethnic minorities mostly (see Bullard, 2008; Pastor, 2007 in Laurent, 2011). Thus, the environmental justice law in the US tends to keep the focus on racial and ethnic issues, paying less attention to problems caused by income or social inequalities (Pastor, 2007). Conversely, the European treatment of environmental inequalities tends to not to frame them in ethnic or racial terms focusing more in socioeconomic disparities (Taylor, 2000, seen in Agyeman, J. et al, 2000; Laurent, 2011), paying special attention to the income levels, material living conditions and housing (Padilla et al., 2014; Brainard et al., 2002; Havard et al., 2009) without considering the possible relationship between other personal characteristics and the incidence of the harmful effects of pollution.

Secondly, both the historical background of the recent formation of the European Union (EU) as a political union and the movement of borders within the EU in the twentieth century (Brown, 1999; Varga, 2000) need to be considered when studying the differences of focus between the US and the EU. Even though the environmental justice became to be relevant in both places at the same time, when Rachel Carsons' book *Silent Spring* was published (1962), the European Union was not even a political union. At that point, the United States, however, was a sovereign nation with all the institutional means needed to elaborate a political agenda to fight against it. This fact is in the root of almost all the relevant differences between the US and the EU, especially when it comes to policy implementation and the divergence in methodologies and the type of academic literature that has been made so far, as we will see later in this work.

Although the beginning of the active environmental policy started in the individual states, Congress adopted its first federal pollution legislation in 1965 and created the Environmental Protection Agency already in 1970. On the contrary, the European institutions did not make an explicit reference to the environment or the environmental policy until 1987 (Krämer, 2002). The fact that short time ago all countries forming the EU had different environmental conditions and policies makes it hard to find literature that considers them as a whole or that gives the same relevance to all countries involved, unlike in the US (Varga et al, 2002). This happens especially in Central and Eastern Europe, where the countries are mostly small and where pollution tends to affect other countries different from the original one.

It is easy to find examples of this conflict between countries and their respective environmental policies. One of them is the case of the catastrophe in the Carpathian Basin caused by an Austrian-Romanian enterprise called Transgold S.A (Burnod-Requia, 2004) where Romanian producers with Austrian capital caused environmental damage to the Hungarian population. The other one is the conflict in the Danube Dam, which was a joint project between Hungary and Slovakia during the communist era. The aim of this project was to effectively use the river, but Hungary withdrew from it when it became a democratic country. The Slovak Academy of Science warned that the redirection of this river to an artificial canal would probably cause environmental damage to Csallóköz (Slovakian territory inhabited by Hungarian population). But still, it was carried out harming the environment and the population of that region. These are representative cases of the conflicts that arise when the effects of pollution are transboundary but there is no unified law and/or a united political formulation and implementation (Schwabach, 1996).

These cases are illustrative of both the complexity and the social dimension of the environmental issues. In academia, the environmental justice paradigm has varied greatly since it was born. Historically, its study has avoided paying attention to the ideological foundations, its principles, and its social construction. Since around 1860 until the beginning of the 20th-century scholars like George Perkins Mars, John Muir and T. Gilbert Pearson focused on the effects of human action harming nature, the intergenerational equity and resource protection (Silveira, 1962; Taylor, 2012). Furthermore, mainstream environmental organizations were characterized by their lack of diversity. They were born around the 1800s and were formed mostly by white, wealthy males that belonged or were close to an elite defined for being class biased and that viewed nature as a place of recreation. Marshall was the first one considering the preferences of the minorities (wilderness lovers). His main argument was that it was unjust to establish a link between how nature should be analyzed and protected and the tyranny of the majority (Marshall, 1930).

However, the notion of environmental justice wasn't fully transformed into what we know and consider now until Rachel Carson, around 1960, incorporated in the analysis the issues regarding human health and the relations between corporations, governments and communities in her book *Silent Spring,* already mentioned before. In this book, she highlighted the harmful effects of pesticides in the environment and the living beings and blamed the chemical industry (Carson, 1962). Her work put the emphasis on the effect of toxins and hazardous pollution on human health and their living conditions.

The main success of this new approach was to extend the environmental concerns to people that would not have cared in the first instance and to poor people and minority residents. This made them be more conscious of the situation and how environmental hazards were worsening their standard of living because of racial, gender and class discrimination. Thus, this new framing was the first analyzing human-nature and human-human relation through the oppression, a term that refers to the discrimination resulting from prejudices related to race, class or gender bias. This discourse also links the discrimination with labor and housing market forces, which illustrates the relevance of the problem. As a result of this change in the approach and the concept, it is no longer possible for scientists to ignore the social justice implications of the environmental hazards (Taylor, 2012).

This shift in focus that came from both social mobilizations and the academic world has had a clear impact not only in the increasing number of activists and social awareness but also in official institutions such as the Environmental Protection Agency (EPA) and the Environmental European Bureau (EEB). In their definitions of the environmental justice concept, they both understand and mention the relevance of the inclusiveness and equal treatment of all people, no matter what their characteristics —income, race, gender— are, in all related to the environmental law's development and enforcement.

When we study environmental problems from the theoretical framework of economic science, we use the concept of externality. We define externality as an activity that generates a positive or negative effect on agents that are not related to that action. This effect is considered an externality when it is not reflected in market prices (Cambridge Dictionary, 2019). The existence of these effects is widely acknowledged in the environmental economics literature (Moreno-Jiménez et al., 2016; Padilla et al., 2014; Marchiori et al., 2016) because it is the main root of the rest of the environment problems. Thus, we can affirm that the market mechanisms don't provoke the ecological adjust needed to guarantee sustainable economic growth. In fact, there is no existing economic system capable of including the externalities in market prices, neither in capitalists' economies, where the incentives tend to be badly designed because of the power of big lobbies and their economic interests nor planned economics where there is a lack of freedom to associate and protest (Martínez-Alier, 2008).

Usually, companies are the ones behind these problems and only the ecology activists are trying to tackle them. We should note that most of the times these activists do not have either the power of influence or resources that the formers do have to accomplish their goals. We can find several examples of companies that are big and strong enough to economically compensate their over-pollution without reducing their emission levels nor considering the public health and environmental issues they provoke. For example, Dow Chemical, which is considered the company with the highest cancer mortality rates (Katz, 2010), and Amvac were accused of using toxic substances in the production processes. Amvac, following what the BBC said, merely paid 300,000 dollars to 13 peasants in order to avoid the trial (Martínez-Alier, 2008). This is only one of the many cases we can easily find in the literature (Katz, 2010).

The study of EJ began with elites that did not care about the social impact of environmental hazards. This approach can also be recently found in international organizations led by orthodox economists who support their position with strict economic logic. A clear example of this can be found in the Lawrence Summer's filtered memo in 1992 (Foster, 1993). In his leaked message he stated that poor countries were under polluted and that the World Bank should send polluting industries there referring to pollution levels exclusively in terms of economic efficiency.

This approach does not value all human lives equally and tends to ignore the fact that minorities and poor neighborhoods could be disproportionately bearing the effects of hazardous pollution. This is what we will check in the following sections. A way to challenge this perspective is assessing the state of environmental justice in Spain by using a perspective that includes these economic and other social conditions in the study of environmental justice. We will go through specific cases in Spain, where there is an evident lack of literature in this respect (Moreno-Jiménez et al., 2016), as in other areas of Europa, such as the East (Varga, 2002).

2.2 Literature review of Environmental Justice assessment

As we stated at the beginning, the first works trying to find out inequities in the distribution of hazardous pollution were made in the United States. By 1994 only three studies focused on this issue through the analysis of commercial hazardous waste treatment, storage and disposal facilities (TSDFs). These are facilities that aim to reduce the impact of hazardous pollutants on the environment and on the standard of living of people inhabiting their surrounding areas. Although we won't focus specifically on the type of pollutants we describe in this section, they are a useful reference as a departure point both to compare results temporarily, since the very beginning and until now, and spatially, comparing the US focus with the focus of the EU.

The first one was conducted by the GAO (Government Accounting Office) in 1983 and it concluded that most of the people living around hazardous waste sites were black. The second, made by the United Church of Christ's Commission for Racial Justice in 1986 considered these three variables: percent minority population, mean household income and mean value of owner-occupied housing. It stated that there was an overrepresentation of black people around polluting facilities. The third one, by Mohai and Bryant (1992), considered economic and racial data. Results of this work, although only applicable to the Detroit area, also concluded that race was more significant than income when explaining the distribution of environmental hazards.

These studies are in the infancy of a field, which implies that their methodologies are not the most advanced ones and that their results might be biased. However, the direction of all of them was clear: environmental racism existed and was empirically tested. In contemporary studies what we find is that, although this relationship still exists and it is significant, it is not always that strong and clear (Downey et al., 2008). Conversely to the US findings, studies in the EU show a variety of results when searching for a socioeconomic pattern within the population surrounding polluted areas.

While some point that the most deprived zones are linked to more polluted zones, mostly due to the proximity to toxic sources (Kruize et al., 2007; Namdeo and Stringer, 2008; Moreno-Jiménez et al., 2016; Padilla et al., 2014), others show that zones with middle-income status population are the ones bearing higher levels of pollution (Havard et al., 2009). We can also find works that prove that there is an inverse relationship between levels of deprivation in a determined zone and its level of contamination (Forastiere et al., 2010). This variety of results is mostly due to the use of different methodologies (Maguire and Sheriff, 2011), which makes it difficult to empirically assess if there is any relationship between the socioeconomic status/minority groups and the level of pollution that they have to bear. This fact supports the idea that more studies following a standardized methodology need to be done (Padilla et al, 2014; Moreno-Jiménez et al., 2016), although we can already find some works trying to fill this technical gap (Maguire and Sheriff, 2011) and standardize study outcomes.

Before carrying out our own empirical assessment, we went through other recent works done in Spain and the rest of Europe. Doing so, we can make a comparative analysis of their methodology and results with ours. The main thesis of these works is that the exposure to hazardous pollution, without paying special attention to the type of pollutant, is directly related to the socioeconomic status. Generally, this effect is explained by the proximity of the deprived groups to the source of pollution (Padilla et al, 2014). In Europe, special attention has been paid to the income level. However, in recent study cases, we can also find analysis considering how other social characteristics affect the probability of being extremely exposed to the harmful effects of pollution. Researchers have tried to test this thesis by analyzing different types of pollutants and considering different types of geographical units. On the one hand, this is useful to give us a general overview of the effects of a variety of hazardous pollutants, although it makes it difficult to compare them and get to a solid conclusion, on the other (Mitchell, 2011; Germani et al., 2014).

For example, in Padilla et al. (2014) they study the spatial relationship between ambient air nitrogen dioxide (NO_2) concentration and socioeconomic characteristics of the population living in four French metropolitan areas. The analysis is made for two different period times, which allows assessing temporal trends in urban air pollution. They run a simple and multivariate regression analysis, in which the dependent variable was the nitrogen dioxide annual average concentration and the explanatory variables were the socioeconomic characteristics. In Viel et al. (2011) they focus on the social characteristics of the population living near to noxious facilities polluting trough air or water on a French industrial region. In this case study, they use detailed socioeconomic data accounting for income and ethnicity and run Bayesian hierarchical logistic regressions.

Moreover, in Moreno-Jiménez et al. (2016) they study if there are any vulnerable population strata that suffer from overexposure to air pollution (NO_2) in Madrid and Barcelona. They used a geostatistical analyst called ArcGIS in which they implemented well-known statistical techniques. More concretely they run independence tests and, also, created an environmental justice scale diagram in MS Excel. In Germani et al. (2014) they test if income level and social-

demographic variables can explain air releases generated by the industrial sector in the selected Italian provinces. In order to do so, they run a probit model with and without instrumental variables.

Air pollution, especially nitrogen dioxide (NO_2) dominates the literature since its exposure varies among different socioeconomic groups (for review, see Jerret et al., 2004; Moreno-Jiménez et al., 2016). CO_2 and an index created by the aggregation of different kinds of air pollutants have been used in other studies (Germani et al., 2014), generally by using air quality monitoring stations located around studied geographical units (Moreno-Jiménez., 2016; Germani et al., 2014). However, researchers are now studying other pollutants and types of negative externalities, such as spatial proximity to potential polluting sites (landfills, abandoned toxic waste dumps…), the pollution effects caused by emitting transportation (Viel et al., 2011), noxious gases and noise from traffic and airports (Moreno-Jiménez et al., 2016).

In all these papers, researchers focus both on socioeconomic and racial/ethnic variables. For example, in Padilla et al. (2014) they use income, educational level, family, household, housing, and employment indicators. Others, such as Viel et al. (2010) add population density as a relevant variable, while in Moreno-Jiménez et al. (2016) they focus on environmental hazards effects within children and the elders. We can even find studies that analyze the impact of pollution in houses with females as the head of the household (Germani et al., 2014). When it comes to racial and ethnic variables studies focus mostly in the immigration status as the percentage of people born abroad (Viel et al., 2010) but we can also find more specific variables such as immigration mobility (Padilla et al., 2014) or studies that focus on a specific kind of immigration. For instance, in Moreno-Jiménez et al. (2016), they consider only the immigration that comes from countries whose GDP per capita is less than the GDP per capita of the European Union, such as Latin-Americans, Africans, Asians and people from East Europe.

Methodologically speaking, assessing the status of environmental justice has become increasingly difficult over the last decade. Thus, making necessary the use of new statistical tests, regression models and spatial matching techniques (Moreno-Jiménez et al., 2016). These methodological challenges are especially hard to overcome when trying to find well-developed statistical tools able to quantify equity or distributional effects (Maguire and Sheriff, 2011). Most of the contemporary researchers have opted for using social deprivation or economic status indexes in their works (Viel et al., 2010; Padilla et al., 2014; Moreno-Jiménez et al., 2016; Germani et al., 2014; Harvard et al., 2009). These are composite measures of several demographic characteristics which aim to quantify the socioeconomic deprivation level across determined areas (Moreno-Jimenez et al., 2016).

Common and standardized indexes are the Gini coefficient and the concentration, the Atkinson and the Kolm-Pollak indexes, which are analyzed in Maguire and Sheriff (2011). Overall, these two last indexes are considered the most suitable to assess outcomes of already implemented policies. It is important to note that although aggregation methods can help us create easily understandable rankings, they can be misleading by being too simple or by including value judgments of their creators (Maguire and Sheriff, 2011).

In Viel et al. (2010) they found that elements such as historical context, urban development, industry needs, the social composition of communities, land market dynamism and selective residential mobility can explain why hazardous pollution in unequally distributed across the geographical units they studied. In addition, in Germani et al. (2014) they also describe technological factors, local environmental regulations and spatial clustering effects as major causes of unequal distribution of hazardous pollution. Furthermore, analyzed literature finds that the consequences of this inequality are mostly related to health and social issues. They range from a high prevalence of morbidity and mortality to high urban pollution and exclusion of minorities (Moreno-Jiménez et al., 2016). In fact, the World Health Organization (2017) defined environmental injustice as a "major modern mortality risk".

3. Data and Methodology

We are going to analyze if variables accounting for the social composition of the Spanish municipalities considered in our study have a statistically significant influence on the quantity of pollution emitted in these geographical areas. We assume that having a polluting facility inside the borders of the studied area exposes its population to the hazardous effects of a determined type of contamination. Thus, we find it interesting to examine if there is any pattern or relevant difference between social characteristics of the population living in areas with high levels of pollution and the social characteristics of municipalities with lower pollution levels, in which individuals are not that exposed.

There are several methodological challenges that we need to consider when carrying out spatial analysis. The first one is determining the correct geographical area. It is widely accepted that outcomes of the analysis in Environmental Justice are sensitive to the researcher's choices, such as the econometric models, the geographical area, etc. (Baden et al., 2007; Noonan, 2008; Noonan et al., 2009, in Schoolman and Ma, 2012). However, there is no clear evidence of which geographical unit is the most suitable when assessing if there is any pattern within the population that lives near a polluted area. In fact, the very concept of "inequity" or "unequal distribution" is vague and must be well defined. However, not a negligible part of the literature written so far use ZIP code areas or even greater geographical areas, such as townships, EPA regions or even states as a unity measure (Anderton et al., 1994; Schoolman and Ma, 2012).

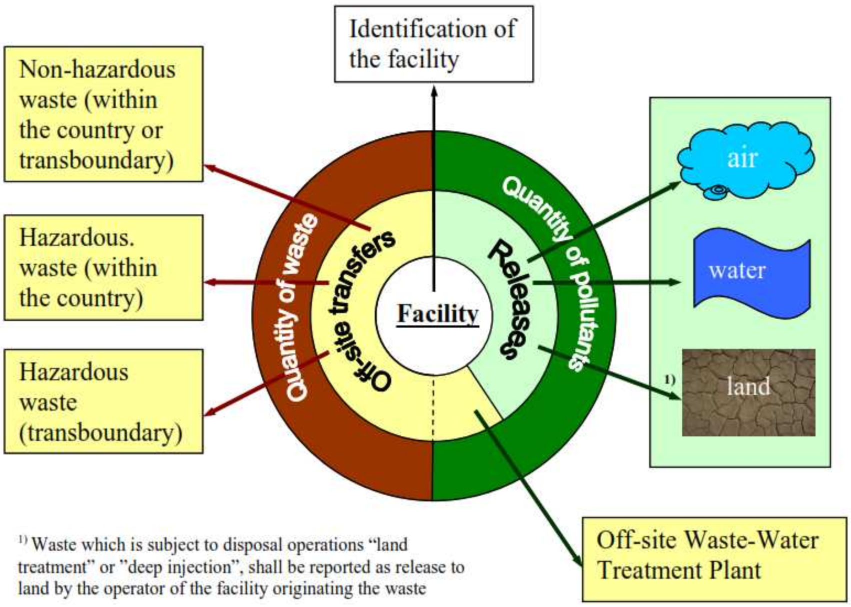
We find quite a few of these examples in the past century in the US (Hamilton, 1995; Zimmerman, 1993; Been, 1995; Hird, 1993, etc.). Nonetheless, when it comes to the spatial extent, and especially over the last decades, local areas are preferred as a unit analysis. Although this approach makes spatial analysis methodologically more complex, recent studies tend to use smaller areas as a unit analysis since they are considered more accurate than those at the countrywide level (Moreno-Jiménez et al., 2016; Viel et al., 2011). More concretely, the smallest unit of analysis that is being widely used lately is a sub-municipal area and it is called "census block". Most of the empirical case studies to which we refer use them as a geographical unit (Moreno-Jiménez et al., 2016; Padilla et al., 2013; Viel et al., 2011).

In our case, we use INE[2] municipal codes, which are the smallest geographical unit available. There is a major critique that can be made when using larger areas. This is, the fact that a facility is located inside a determined area does not necessarily mean that the entire population is equally exposed to pollution (Schoolman and Ma, 2012). However, we will use this unit mainly because our socio-economic and pollution databases are organized at that geographical level. Furthermore, in Anderton et al. (1994) they found that residential segregation patterns were only consistent in larger areal units of analysis. This may be due to the fact that larger areal units of analysis are more likely to contain inside their borders both the polluting facilities and the neighboring communities, which provide us with more comprehensive information.

The data that we use come from four different databases. When accounting for the pollution we use the European Pollutant Release and Transfer Register (E-PRTR), created with the methodology of Material Flow Accounting (MFA). This is a system that weights in physical units the primary materials extracted from the territory and, also, the exported and imported ones, which are grouped and classified, so they can be used for their afterward analysis (Martínez-Alier, 2008). In this regulation there are a set of activities specified in Annex I, that must be reported if the applicable thresholds by type of pollutant. It also provides information on releases of pollutants to air, water and land, pollutants in wastewater and off-site transfers in all European countries, as we can see in figure 1 (Regulation, E. P, 2006). Data used is from 2013. The complete Annex I of the E-PRTR is included at the end of this work, in table 1 of the Annex.

[2] Instituto Nacional de Estadística (Spanish Statistical Office).

Figure 1. Classification of pollutants included in the E-PRTR



Source: E-PRTR Regulation

Within the last category of off-site transfers there are three subcategories: non-hazardous waste (within the country or transboundary), hazardous waste (within the country) and hazardous waste (transboundary). In our work, we will focus only on this type of contamination, which has been constantly increasing in Europe in recent years. Concretely, in 2007 there were 42515 cases of off-site transfers of waste. In 2013, however, there were already 59430 cases reported. An increase of 28,4%.

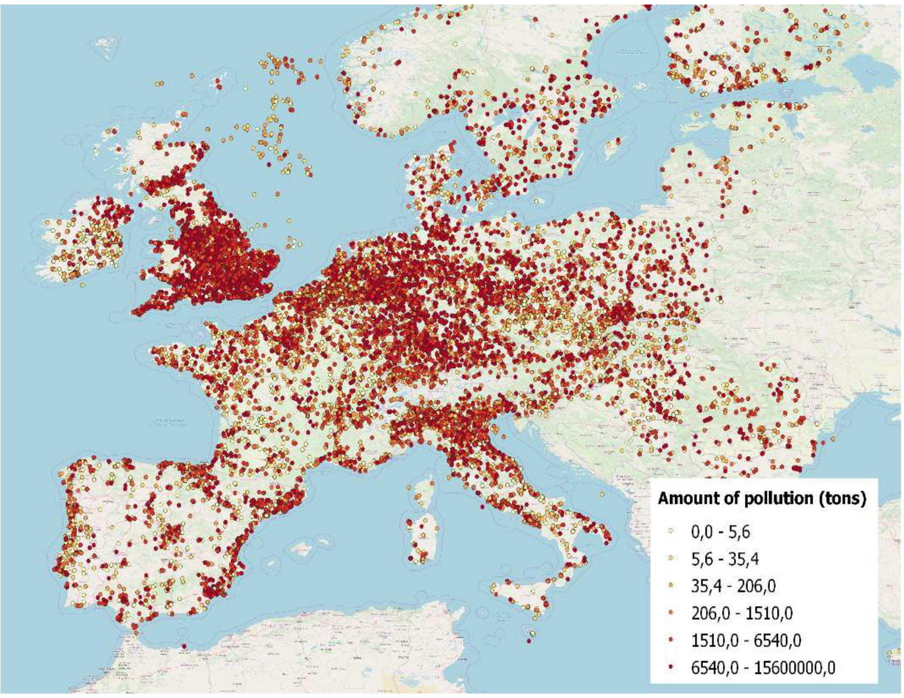
Moreover, we will pay special attention to data accounting for hazardous waste within the country, since it is potentially the most harmful for the population living nearby. This type of contamination is mainly produced by industries and is defined in the article 1(4) of Directive 91/689/EEC as a, "any other waste considered by a Member State to display any of the properties listed in Annex III of the E-PRTR regulation such as flammable, corrosive, oxidizing, harmful, toxic, carcinogenic, explosive, infectious, teratogenic and releasing toxic gases in contact with water, among others. In addition to the hazardous waste list". All these cases shall be notified to the Commission.

Non-hazardous waste, however, is defined as the industrial production excesses that are not inherently dangerous, such as paper, wood, plastics, glass, metals and chemicals, as well as other materials produced by the economic activity. More specific information about this type of pollution can be found in the "List of Waste" (LoW) of the European Union. The main purpose of this list to harmonize the data not only for administration purposes but also for statistical analysis. Although this list is quite complete, it faces evident classification problems. More specifically, these problems are:

Firstly, although there are 839 waste codes, these are not enough and sometimes their labels are not very accurate. Secondly, there are a relevant number of codes that represent a small portion of the waste generated and classified. Furthermore, there are also problems concerning the ambiguous classification on account of two or more possible codes. Hence, hazardous waste can be inappropriately listed in the absence of suitable codes, which could lead to inadequate waste treatment. In fact, this problem is already considered several Member States and stakeholders (Sander et al, 2008). There is even a new category called "usually hazardous waste entries", which implies that there might be non-hazardous waste being misclassified. Thus, we include non-hazardous waste data in our study not only because of these reasons but also because although this type of contamination is not harmful itself, its bad management can have a negative effect in the standards of living of the population living nearby. In conclusion, for everything said before, we consider both hazardous and non-hazardous off-site waste transfer in our work.

Regardless of these issues, the LoW is the most comprehensive classification of waste that can be found at the European level. It is used and recognized by the majority of European countries. Figure 2 shows how these three types of off-site transfers of waste are distributed in Europe. We created a label for the tons contaminated for each facility that ranges from yellow, if the pollution levels are low, to red, if they are high. Having a look at this figure, we realize that the spatial distribution of off-site transfers in Europe is not homogeneous; in fact, the concentration of polluting points is especially high in the center of Europe, the north of Italy and the south of the United Kingdom. If we compare it with the rest of Europe, Spain's concentration of polluting points seems to follow a different pattern. We elaborate on this later.

Figure 2. Spatial distribution of off-site transfers of waste in Europe



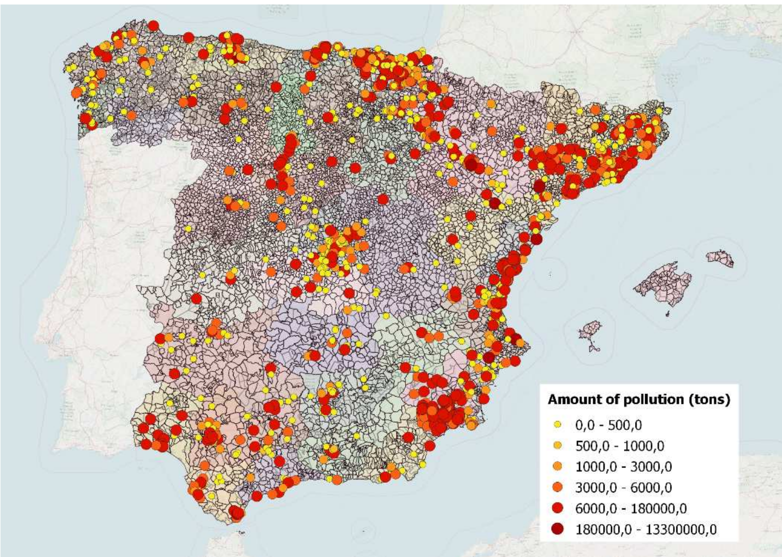
Source: prepared by the author, based on E-PRTR information using qGIS software.

Concretely in Spain, we will consider both hazardous and non-hazardous waste. However, we won't refer to transboundary off-site transfers of waste when identifying points in our map nor running the statistical analysis. On the one hand, we exclude them because our study is focused on Spain. Thus, is not relevant for us the waste generated inside of the country that is going to be transported abroad.

On the other hand, the amount of data available for transboundary off-site transfers of waste in Spain is not enough to consider them relevant. Concretely, out of 4,560 points in Spain where we locate hazardous waste, only 47 of them are identified as transboundary waste, which is around 1% of the total. In Europe this percentage is higher, 5,4%. This may be because Spain is in an extreme of the continent, which makes it harder for this country to share its waste with other neighboring countries. Thus, obviating this information will not have relevant consequences in our analysis.

Although we study both types of waste, we must note that most of our data refers to hazardous off-site waste transfers. Concretely, more than the 70% of our data are coordinates pointing the location of facilities that produce off-site transfers of hazardous waste. Figure 3 shows the spatial distribution of the already mentioned pollutants in Spain. In this map, in the same way than in figure 2, each point represents a pollutant facility with its associated emission quantity (in tons). We decided to create a label for the dots' color and size, so they don't only represent where the pollution is located but also its magnitude.

Figure 3. Spatial distribution of hazardous (within country) and non-hazardous waste in Spain



Source: prepared by the author, based on E-PRTR information, using qGIS software.

Pollution points of hazardous and non-hazardous off-site transfers of waste in Spain are concentrated in the "Mediterranean corridor". This area includes Catalonia, the Autonomous Community of Valencia and Murcia. It is known for having high rates of tourism and economic activity. However, not only the actual characteristics of the studied areas are determinant, but the historical background also plays an important role when explaining the level of economic development and industrialization of a region. This happens especially in Catalonia and in the Basque Country, which were the most advanced industrialized zones. In fact, around 1910, these two regions accumulated 61% of total employment in metallurgy, chemicals, engineering and textiles (Rosés, 2003). There, as we can easily see, the concentration of polluting points is amongst the highest. This also happens in Madrid and the rest of the northern part of Spain. We can find literature referring both to the wide historical industrial context of Asturias and the consequences that it has had and has on the environmental quality (Ordóñez et al., 2013; Loredo et al., 2003; Loredo et al, 1999).

More generally, actors widely accepted as determinants of the distribution of pollution are, on the one hand, economic growth and the type of economic activities carried within the territory and, on the other hand, the spatial concentration level of the population. However, there is a great level of interdependence between all of them. This prevents us of categorically affirming that economic activity or growth always affects negatively to the environment. In fact, if this was strictly accurate, we should not observe polluted zones where there is no substantial level of economic activity and concentration of population. However, the reality is more complex than this.

Firstly, economic growth has both positive and negative impacts on the environment. The result of economic activities in the quality of the environment depends on the specific combination of these factors, which is empirically hard to identify and model. Secondly, other factors, such as the type of pollution that is being analyzed or the need for human capital of the polluting activities carried, tend to be underestimated. This is, if the economic activities need for workforce living near the facility, factors such as the housing market, the price of land or the availability of commodities in the area start to play an important role and need to be considered. Thus, the relationship between a high level of economic growth and great levels of pollution is changing constantly, with makes evident the need for empirical studies with standardized methodologies to identify this relationship in a specific area (Blinder, 2002).

The mechanisms behind what and how to report are also relevant. There are four types of emissions considered: deliberate, routine, accidental and non-routine contamination. Deliberate and routine are the most common. Accidental emissions are those that are not deliberate, routine or non-routine and under uncontrolled circumstances when developing an activity specified in Annex I. Conversely, non-routine emissions are produced under controlled situations, and come as a result of start-up or shut-down processes and tend to increase the release of the pollutants. Operators must report all kind of releases when the information is available and if the threshold is exceeded. Particular attention must be paid to the estimation of accidental releases since this data is not always immediately available to the operator.

Operators of facilities carrying out one or more activities already mentioned in the Annex I must report this information to its competent authority. It should also be specified whether the information has been measured, calculated or estimated. Thresholds for releases to air, water and land are specified in Annex II of the E-PRTR Regulation. Thresholds for the kind of pollution we are interested in are 2 tons per year for hazardous waste and 2,000 tons per year for non-hazardous waste. In addition, it should be pointed out whether the waste is destined for recovery "R" or disposal "D" (The European Commission, 2015).

In our statistical analysis, we use pollution information as the dependent variable and the rest of the socioeconomic variables as explicative variables. We used the information coming from the E-PRTR in the following way. Firstly, we created a dummy variable which takes the values 1 if there is any polluting facility inside the borders of the municipality and 0 if there is not. Secondly, we created another variable that is the result of the sum of contamination reports made by each facility. Thirdly, we did the same with the quantity of pollution emitted by the total of polluting facilities for each municipality.

The pollution information we have available comes both with the ZIP codes of the location of the facilities and the names of the municipalities, that match with the INE codes used as an identifier in the E-PRTR database. Thus, the smallest geographic unit of information when it comes to the socioeconomic variables available in the INE is the INE code of municipality. This is the reason we decided to run all the analysis at the municipality level, since we are especially interested in the socio-economic characteristics of the geographical areas studied.

Specifically, when accounting for socioeconomic characteristics of the population we use three other databases. Firstly, the Statistic of the taxpayers of the Income Tax of the Physical Persons by municipalities, from the State Agency of Tax Administration[3]. This database presents the most relevant information related to the Income Tax of Physical Persons. From this database we obtain the mean disposable income of each municipality with more than 1,000 inhabitants. Information of individuals living in municipalities with less than 1,000 inhabitants is individualized and included at the Autonomous Community level for confidentiality reasons, whereas for the rest of the information is presented at the aggregated level. For us, this does not pose a relevant problem since, usually, these municipalities are too small to have enough infrastructure to develop substantial economic activity —especially in the industrial and building sectors, which are the ones we are interested in.

Secondly, the socioeconomic data by municipalities comes from the INE. From this database we obtain information about the total population and the mean age of each municipality. For assessing if the percentage of immigrants influences and the level of population in a determined municipality, we use the percentage of the total of immigrants. We decompose this percentage in the total of immigrants coming from the UE and the non-UE citizens. We assume that for those coming from the UE it should be easier to integrate into the Spanish society, due to inclusion programs of the UE, such as the Erasmus+ and aid programs. Furthermore, we should bear in mind that moving from an EU country to another has fewer costs that coming to the EU without having EU citizenship. However, we are conscious that this assumption doesn't always hold but still, we have enough reasons to consider it in this specific way.

To control for the sectoral economic composition of each municipality we included the percentage of industrial facilities, the percentage of facilities of the construction sector and the percentage of facilities of the services sector. Finally, we included a categorical variable to

[3] In Spanish, Agencia Estatal de Administración Tributaria (AEAT).

control for Autonomous Communities. A different number has been associated with each Autonomous Community, as can be seen in table 1. As a final step, we merged these three databases in one that contains all the information we need to analyze.

Each municipality has its name and its INE code assigned, which we used to gather all the information. The surface area varies widely across municipalities, from Cáceres (1750,33 km^2) to Emperador, Valencia (0,03 km^2). Mean surface area of municipalities at the national level is 62,73 km^2 (Instituto Nacional de Estadística, 1987). We must note that there are provinces that are not considered in our analysis, either because there was not enough pollution data, which is the case of Las Palmas de Gran Canaria, Santa Cruz de Tenerife, the Balearic Islands, Ceuta and Melilla or because they are not considered in the Statistic of the taxpayers of the Income Tax of the Physical Persons. This is the case of Navarra and the Basque Country (País Vasco), which are outside the Common Tax Regime[4]. In any case, we still have a total of 2,637 observations, which is a large enough sample to draw some conclusions from the regression.

4. Discussion of results

Variables chosen to run the analysis are the mean disposable income (*dispincome*), the population density (*denspop*), the percentage of immigrants coming from UE countries (*pimmue*) and the percentage of non-UE immigrants (*pimmextra*), the mean age of each municipality (*age*), the percentage of industrial facilities (*pindus*) and the percentage of service facilities (*pserv*). We also included a categorical variable controlling for the effect of the Autonomous Communities. In our case, there are 13. We assigned a different number to each one of them, as can be seen in table 1.

Table 1. Autonomous Communities (*ccaa* variable)

Andalucía	1
Aragón	2
Asturias	3
Cantabria	4
Castilla y León	5

[4] In Spanish "Territorio de Régimen Fiscal Común" (TRFC).

Castilla-la-Mancha	6
Cataluña	7
Comunidad Valenciana	8
Extremadura	9
Galicia	10
Madrid	11
Murcia	12
La Rioja	13

Our variable accounting for the number of reports (*facpoll)* does not necessarily represent the level of exposure, since making an only report does not mean that that facility is polluting less than a facility that makes several reports with a lower total quantity of emitted pollution. Therefore, out of the three variables we created accounting for pollution, we chose the quantity (*qpoll*). This carries the most representative information to measure the exposure level of municipalities to hazardous and non-hazardous pollution. It is important to note that the tobit model we decided to run is a form of a linear regression that considers and differences between the zeros (skewed and censored data) and the quantities that are strictly higher than zero.

Before explaining and running our model in a more detailed way, we give a descriptive analysis of the data. Therefore, in table 2, we summarize all the variables of our regression.

Table 2. Statistic description of the variables

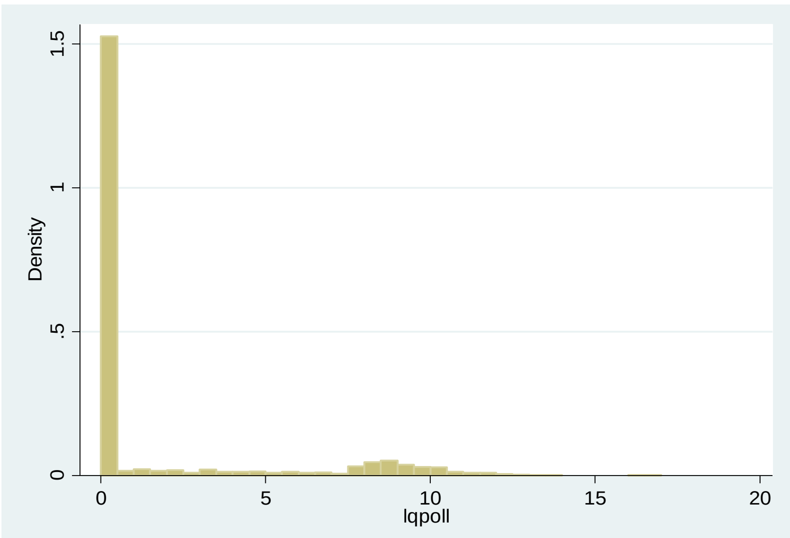
```
. sum qpoll dispincome denspop pimmue pimmextra age pindus pserv ccaa
```

Variable	Obs	Mean	Std. Dev.	Min	Max
qpoll	2,813	22008.11	551967.2	0	2.42e+07
dispincome	2,814	16509.96	3681.222	9613	44043
denspop	2,812	383.39	1273.536	1.5	21296.13
pimmue	2,813	.0522538	.071273	0	.71
pimmextra	2,813	.0409883	.0426782	0	.39
age	2,813	42.87927	4.784816	30.82	59.78
pindus	2,644	.099792	.0534217	.01	.46
pserv	2,737	.2723712	.093937	.05	.68
ccaa	2,814	6.003198	3.340972	1	13

Source: prepared by the author, using Stata software.

Our dependent variable is measured in tons of hazardous and non-hazardous waste per year. The mean is 22,008.11 tons, with a standard deviation of 551,967.2. The minimum is 0 and the maximum is 24,200,000. However, the fact that a quantity is 0 does not necessarily mean that there is no pollution in that specific municipality, which implies that there might be more zeros that are not actually zeros but pollution that has not been reported, since operators are not obligated to do it. This might be the reason why there are that many zeros and the reason why we use the tobit model. This can be easily seen when we look at the histogram. However, when running the regression, we transform this variable into logarithms.

Table 3. Data distribution of the quantity of pollution emitted



Source: prepared by the author, using Stata software.

The rest of the variables will be our explanatory variables. First, we have the mean disposable income of each municipality (*dispincome*), which is measured in euros. The mean of this variable is 16,509.96, with a standard deviation of 3,681.22 euros. In our regression, this variable is also transformed into logarithms. The population density (*denspop*) is measured in inhabitants per km2. The mean population density is 383.39 with a standard deviation of 1,273.53, which makes sense since we take both small and big municipalities and municipalities with small and large populations. In fact, our population data ranges from 1,001 to 3,165,235 inhabitants. This variable is also transformed into logarithms. Therefore, the interpretation of all of the three variable's coefficients will be the ones of a log-log model.

Following this, we have immigration variables. We use the number of immigrants coming from EU countries out of the total of immigrants, and the percentage of immigrants coming from non-EU countries (*pimmeu* and *pimmextra*, respectively). For EU immigrants the mean percentage is 5.22%, and the standard deviation is 7.12%. For those coming from non-EU countries mean percentage is 4.09% and its standard deviation is 4.26%, with a minimum of 0% and a maximum of 39%. For assessing the effect of the average age of each municipality we use the variable *age*. This variable is measured in years. The total average age is 42 with a standard deviation of almost 5 years. The minimum is 31 and the maximum is about 60. In the regression we use both *age* and *age* squared it to check if the effect on pollution gets stronger or lessened as the average age of a municipality gets higher.

To control for the sectorial economic activity of the municipality we included the total industrial, construction and service facilities out of the total (*pindus, pcons and pserv,* respectively). These variables are measured in percentages. At first, we run the tobit regression with *pserv* but it turned out to have a p-value higher than 0.5, which made us drop it since it did not have a statistically significant influence in the quantity of pollution. The other variables, however, are statistically significant. The mean of industrial facilities is 9.9%, with a minimum of 1% and a maximum of 46%. The mean of service facilities is 27%, the minimum value is 5% and the maximum of 68%. Finally, we included a categorical variable controlling for the effect by Autonomous Communities, this variable will be better described when analyzing the results of the regression. Our model represented in an equation is:

$$lqpoll = \beta_0 + x_1 lndispincome + x_2 ldenspop + x_3 pimmeu + x_4 pimmextra \\ + x_5 age + x_6 age^2 + x_7 pindus + x_8 pserv + x_9 i.ccaa + \varepsilon_i$$

After this descriptive analysis of the data, we decided to use a tobit model (censored regression model) to estimate linear relationships between variables. This model assumes that there is either right or left (below or above, respectively) censoring of the dependent variable. In our case, we use the right (below) censoring. As we said before, operators are only obligated to report their level of emitted pollution if it exceeds 2 tons per year of hazardous or 2000 tons per year, for non-hazardous wastes.

Although we are including both hazardous and non-hazardous waste in our analysis, we are mainly interested in hazardous waste, since this type of contamination is undoubtedly dangerous for the exposed population. Thus, 2 tons per year is the applicable threshold in our case. Since we cannot observe pollution levels below 2 tons, as can be seen in table 4, we do not have complete certainty that all zeros in our sample are real zeros. Some zeros might be zeros because operators have decided to not to report their pollution emissions, but they are, in fact, polluting.

Table 4. Tabulation of *qpoll*

Tons of waste	Freq.	Percent	Cum.
0	2,147	76.32	76.32
2.04	2	0.07	76.40
2.08	1	0.04	76.43
2.24	1	0.04	76.47
2.32	1	0.04	76.50

Source: prepared by the author, using Stata software.

Since there are no values between 0 and 2, all we know when there is a 0 is that the quantity could be less or equal to 2. Thus, censoring is a useful tool when the survey design has a limit of detection, which is our case.

Table 5. Outcome of the regression


```
Tobit regression                                Number of obs     =      2,637
                                                LR chi2(20)       =     476.09
                                                Prob > chi2       =     0.0000
Log likelihood = -3103.1921                     Pseudo R2         =     0.0712
```

lqpoll	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lndispincome	12.88554	2.630982	4.90	0.000	7.72652	18.04455
ldenspop	1.155456	.2105506	5.49	0.000	.7425935	1.568319
pimmeu	-5.858355	4.611873	-1.27	0.204	-14.90164	3.184931
pimmextra	24.96115	6.679011	3.74	0.000	11.86447	38.05783
age	3.496509	.8928933	3.92	0.000	1.745661	5.247358
age2	-.0436	.0104564	-4.17	0.000	-.0641037	-.0230963
pindus	29.733	5.471374	5.43	0.000	19.00434	40.46166
pserv	8.682973	4.820626	1.80	0.072	-.7696532	18.1356
ccaa						
1	5.113761	1.41404	3.62	0.000	2.341011	7.88651
2	7.062344	1.581177	4.47	0.000	3.96186	10.16283
3	11.54394	2.010752	5.74	0.000	7.601118	15.48677
4	6.526887	1.855936	3.52	0.000	2.887636	10.16614
5	6.680225	1.414885	4.72	0.000	3.905819	9.454632
6	4.533719	1.410959	3.21	0.001	1.76701	7.300428
7	3.926168	1.207565	3.25	0.001	1.558289	6.294047
8	5.040647	1.36891	3.68	0.000	2.356392	7.724901
9	4.44113	1.850243	2.40	0.016	.8130426	8.069217
10	7.638964	1.591288	4.80	0.000	4.518654	10.75927
12	8.682384	2.005904	4.33	0.000	4.749065	12.6157
13	2.529678	2.43546	1.04	0.299	-2.245946	7.305301
_cons	-217.0312	33.44644	-6.49	0.000	-282.6153	-151.447
/sigma	8.871635	.2894162			8.304127	9.439142

```
          1,981  left-censored observations at lqpoll <= 0
            656     uncensored observations
              0 right-censored observations
```

Source: prepared by the author, using Stata software.

Since there are no values between 0 and 2, all we know when there is a 0 is that the quantity could be less or equal to 2. Thus, censoring is a useful tool when the survey design has a limit of detection, which is our case.

In the table, most of the coefficients are statistically significant at a 95% level of confidence. However, the percentage of service facilities has a significant effect at a 90% of confidence level, which is still a high level. Conversely, there are two variables that are not statistically significant: the percentage of immigrants coming from EU countries and the difference between the amount of pollution of Andalucia against the pollution levels of Madrid. This means that the coefficient could be zero, which would make that variable not to have any effect on the dependent variable. In our case, since the data is at the aggregated level, we are more interested in the direction of the effect, as long as it is statistically significant, than in the magnitude itself.

For the first independent variable of the regression we can interpret that, for a 1% increase in the disposable income, there is a predicted increase of 12.88% in the tons of pollution emitted.

This is, there is a positive relationship between these variables. In some of the studies we reviewed in section 2.2, there is a negative correlation between income and the level of pollution faced. In these papers, the income variable is used as a proxy of deprivation or living standards, meaning that those living in deprived zones, with lower income levels, are more likely to suffer from higher levels of pollution. A result like this one would confirm that there could be environmental injustice.

Nonetheless, our data includes small as well as big municipalities. It makes sense for us to think that in smaller municipalities the mean income is likely to be more representative of the quality of life; however, in bigger municipalities, both in inhabitants and in km^2, the mean disposable income does not necessarily have to represent that. In fact, in these big municipalities, there are usually different neighborhoods with different commodities and levels of deprivation. So, we can say that the mean income of a village with 1,001 inhabitants is more likely to represent the economic development of the whole municipality that the mean income of a city with more than 300,000 inhabitants.

Therefore, if we assume that in our case *lndispincome* is closer to a proxy for economic development than to a deprivation measurement, it makes sense that the coefficient is positive. Something similar happens with the population density, but this time the magnitude of the effect is lower, which means that the positive relationship is not that strong. This is, for each 1% increase in the desity of population, there is a predicted increase of 1,1% in the tons of pollution.

If we have a look to the percentage of immigrants coming from an EU country, living in a determined municipality, we realize that this variable has a negative but not statistically significant relationship with the tons of pollution born by that municipality. Nevertheless, the relationship is positive and statistically significant between the percentage of extracommunitary immigrants and tons of pollution. Its coefficient is amongst the highest, which means that this variable is strongly related to the tons of pollution emitted in a determined municipality. This is an interesting result of our study, since it makes us think that there could be some kind of environmental injustice, meaning that being an immigrant from a non-EU country increases the odds of living in a more polluted municipality. We will not try to establish a causal relationship, but this result tells us that it would not be surprising to find one.

When it comes to the mean age variable, our results indicate that the higher the mean age is, the tons of waste also increase, but when the mean age reaches a determined point this growth in pollution is slower. Moreover, as we expected from the beginning, there is a strong positive relationship between the percentage of industrial facilities and the levels of pollution. In fact, together with the percentage of non-EU immigrants, its coefficient is one of the highest. There is also a positive relationship between the percentage of service facilities, but this one is lighter. This result is not strange since the kind of pollution we are considering is mostly a product of the industrial facilities.

Finally, we also included the Autonomous Community variable. The 11 Autonomous Community (Madrid) was used as a base level. The p-value of all of them but the 13 (that refers to La Rioja) is less than 0.05 which means that, controlling for the rest of variables the level of pollution of the rest 11 Autonomous Communities is significantly different from the level of pollution of Madrid. Since this is a categorical variable, the interpretation of its coefficients is slightly different. For example, for the case of Asturias (3), which is the Autonomous Community with the highest coefficient, we can interpret it by saying that under the same circumstances, and controlling for the rest of variables, pollution in Asturias would be considerably higher than in Madrid. Another example of how to interpret this is the case of Catalonia (7). The circumstances of Madrid and Catalonia in terms of population density, mean income, percentage of industrial facilities, etc… may be similar. Therefore it makes sense that, controlling for the rest of variables and with similar levels of pollution the coefficient is closer to that of Madrid.

5. Conclusion

Although the EJ is a concept that has been constantly gaining currency over the years it has not had the same impact in all countries. In fact, Mitchell (2011) states that this field is still in its infancy and that we are far away from the rigorous assessment of the inequalities coming from the unequal distribution of environmental hazards. Furthermore, as Mohai et al. said (2009) ''it is not immediately obvious what should be done after an injustice has been documented –addressing environmental injustice with public policy could involve complex and expensive local, national, or perhaps even global interventions."

Considering this, the US is the most advanced country in the study of EJ, since the concept was born there and because they already had the necessary political and social structure to develop and study this field in a broader way. Thus, we have chosen to follow their path by evaluating the state of the EJ in Spain. However, or analysis uses a general scope by considering all Spanish municipalities with more than 1,000 inhabitants and analyzing the most relevant variables for us: income and nationality, amongst others.

Taking into account the limitations on data availability, such as not having socioeconomic information in a census block levels and the possible misclassification of non-hazardous pollution we are able to draw some conclusions from our analysis. The most relevant ones are, in the first place, that pollution is not equally distributed in Spain, as we showed in the qGIS. And secondly, that the percentage of immigrants from non-EU countries is larger in municipalities with higher pollution levels. To get to this conclusion we run a tobit model in Stata, since it was the model that allows us to overcome problems coming from the way the database was designed.

This result drives us to further research on a smaller scale and with more detailed socioeconomic data focusing on deprivation. Also, we bear in mind two relevant points for future works. Firstly, a more comprehensive approach is needed. Secondly, more advanced and standardized measuring methods, to allow for international comparison, need to be applied. We consider that many different appraisals fit in EJ spatial analysis, such as temporal comparisons or the estimation of public policy outcomes, in addition to linking it with health issues.

Our final aim is not only to identify which population groups suffer from disproportionate exposure to pollution, if there are any, but also to promote the inclusion of the EJ assessment in the public policy in Spain. This way, we pretend to protect those that are already suffering this unjust distribution and enhance the EJ state of the country through a change in how urban planning and policies are designed. We consider it is time for the EJ to form a fundamental part of the public debate and regulations. Therefore, any contribution from researchers on this subject is welcome and will be determinant in helping us to accomplish this high goal. Finally, we hope that this research contributes to creating a public debate that gives relevance to the environmental justice concept.

Paper formatting

The total length of the paper should not exceed 25 pages and maximum size of 2MB. It should be sent in Microsoft Word (.doc) using the attached pattern.

The paper should be divided into numbered sections (bold).

Tables and figures should be numbered consecutively in accordance with their appearance in the text.

Text should be 12-point Times Roman, typed in 1.5 spacing. Before and after paragraph spacing should set to 6 pts.

Page numbers should be in the bottom center (expect the first page).

Bibliography. Please follow these sample references:

World Bank (2002): *Cities on the Move: a World Bank Urban Transport Strategy Review, World Bank, Washington DC.*

Becattini, G. (2002): "Del distrito industrial marshalliano a la ‘teoría del distrito’ contemporánea. Una breve reconstrucción crítica", *Investigaciones Regionales*, nº1, p.9-32.