

Waste Management in the Spanish Municipalities: Is Commitment to Local Agenda 21 more than Good Intentions?

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ABSTRACT: Spain is one of the European countries with more municipalities adhering to the Local Agenda 21 (LA21). Environmental spending exerts a great influence on implementing LA21. But some authors raise doubts about the firm commitment of local governments to LA21 objectives.

Thus, the main objective of this paper is to verify whether political commitment is backed up with action towards meeting the objectives of sustainable development by means of budgetary support for waste management policies.

To accomplish this, we applied the Difference in Differences technique for the period 2002-2012 in the Spanish municipalities. Our initial results confirmed the original hypotheses and showed that local governments that adhered to LA21 were genuinely committed to achieving at least one LA21 goal and offering greater budgetary support for waste management. However, the sensitivity analysis revealed unexpectedly ambiguous evidence about the research question, in that we observed a great volatility of results depending on the sample and dependent variables chosen.

JEL Classification: H72; Q53; Q58; C21; C33.

Keywords: Local Agenda 21; waste management; difference in differences.

La gestión de residuos en los municipios españoles: ¿Hay algo más que buenas intenciones tras la adhesión a la Agenda 21 Local?

RESUMEN: España es uno de los países europeos con más municipios adheridos a la Agenda 21 Local (AL21). El gasto medioambiental ejerce una gran influencia

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en la implementación de la AL21. No obstante, algunos autores han planteado dudas sobre la existencia de un compromiso real por parte de los gobiernos locales con los objetivos de la AL21.

Así pues, el principal objetivo de este trabajo es verificar la autenticidad del compromiso político hacia el cumplimiento de los objetivos de desarrollo sostenible por parte de las autoridades locales, reflejando dicho compromiso en el apoyo presupuestario a las políticas de gestión de residuos.

Para llevar a cabo tal verificación aplicaremos la técnica conocida como Diferencia en diferencias sobre los datos presupuestarios de los municipios españoles durante el periodo 2002-2012. Los resultados inicialmente obtenidos confirmaron que los gobiernos locales adheridos a la AL21 están realmente comprometidos con al menos un objetivo de la AL21, el relativo a la gestión de residuos, y dicho compromiso se ve reflejado en un mayor apoyo presupuestario. No obstante, el análisis de sensibilidad puso de manifiesto la existencia de una inesperada y ambigua evidencia respecto a la pregunta de investigación. Se observa una notable volatilidad de los resultados dependiendo de la muestra y la variable dependiente elegida.

Clasificación JEL: H72; Q53; Q58; C21; C33.

Palabras clave: Agenda Local 21; gestión de residuos; diferencia en diferencias.

1. Introduction and objectives

With the signing of the Aalborg Commitments (Aalborg+10), local governments accept their responsibilities to adopt a list of 50 qualitative objectives organized into 10 themes. Three out of 50 objectives are related to waste management: the avoidance and reduction of waste along with increased reuse and recycling; the management and treatment of waste in accordance with best practice standards; and, the promotion of climate protection policy embedded in policies such as energy, transport, procurement, waste, agriculture, and forestry.

The six main drivers that influence waste management have been identified as public health, environmental protection, value of waste as a resource, «closing the loop», institutional and responsibility issues, and public awareness. The influence of each driver has changed over time and among countries, depending on their level of development as well as their strategies. These drivers are integrated and connected with all the aspects related to sustainable development (Wilson, 2007).

Traditionally, local governments have played a relevant role in waste management. Municipal solid waste generation is affected by different factors, such as population, socioeconomic development, and income level. In general, the greater the economic prosperity, the greater the amount of waste produced (Singh, Laurenti, Sinha and Frostell, 2014).

Nonetheless, in recent years, European economic production and consumption have become less waste intensive. One of the objectives in the EU waste policy is to reduce waste generation in absolute terms, within the overall goal of decoupling eco-

conomic growth from resource use and environmental impacts. In fact, waste prevention efforts across Europe seem to be making a positive contribution towards these objectives, albeit with considerable differences between the countries.

Basically, the term sustainability has been identified with an alternative, environmentally friendly, socially equitable, and sustainable development model. This term is an ambivalent concept, however, that raises two serious questions —first, the need to focus on political, social and economic issues, and, second, the need to define potential strategies to transform the current model. The Local Agenda 21 (LA21) meets these objectives and, therefore, is one of the main instruments of management and intervention conducive to sustainable development («European Sustainable Cities Platform - AALBORG +10», 2004).

Nevertheless, several studies have questioned the authenticity of political commitment towards meeting the objectives of sustainable development by local governments that have adhered to the LA21. This concern prompted the first research question addressed in this paper: Do the municipalities that adhere to the LA21 devote a larger share of their budgets to waste management expenditures? Thus, the idea is to link waste management expenditure with the political commitment of local governments so as to achieve the goals set by the LA21. The second research question attempts to gain deeper knowledge about the influence of the political character of local governments, the number of inhabitants, and the volume of the overall budget in waste management expenditure.

The main objective of this work is to measure the differences, in terms of the evolution of waste management spending, between Spanish municipalities that adhered to the LA21 and those that did not.

In order to carry out this main purpose, four specific objectives were defined. The first target is to compare the behavior of municipalities in the control group (non LA21 municipalities) with that of the experimental group (LA21 municipalities). The next three specific objectives are oriented towards getting a better understanding about the influence of three factors in waste expenses —the political orientation of local governments, the population size, and the overall volume of budgetary funds.

This paper offers some differential innovations that exemplify its originality in relation to previous publications in this field. All of them are related to methodological aspects. While other studies are based on the economic classification of budget, in this investigation the dependent variable is the waste management expenditure, understood from the perspective of the functional classification of municipal budgets. Furthermore, the methodology implemented for measuring the impact of public policies is *Difference in Differences* (DiD), instead of ordinary least square models. And, finally, municipal entities are utilised as the unit of analysis, in contrast with the use of provinces or regions in other works.

We did not find answers to these questions in the existing empirical literature on the assessment of LA21 experiences. Thus, in our opinion, this work, which is focused on local expenses for waste management, offers a novel approach in its evalua-

tion of LA21 in terms of political commitment to environmental objectives. From the economic policy perspective, this assessment contributes to verifying how the disclosure of preferences, in favour of environmental actions at the local level, is reflected in specific expenditure programs, and how some quality of life objectives play a part in the allocation of budgetary resources.

This work cannot be considered an overall assessment of the implementation of the LA21 or the effectiveness of these policies in Spain. Neither do we try to explain the determinants of waste management expenditure in local budgets. Our paper addresses a concrete research question: Did LA21 municipalities increase their budgetary resources for waste management policies more than those municipalities that did not adhere to it?

The following section offers a literature review focused on the development of the LA21 in Europe and in Spain in particular, as well as on the specific conditions of the provision of solid waste services in Spanish municipalities. At the end of this section, the hypotheses to be tested will be specified. The methodology section designates the temporal and geographical scopes of the work, the data sources, and the treatment of these data for the selection of the final sample. Then, in the results section we will present our findings obtained from the econometric models (DiD). We close the work with a conclusions section, in which the results which refer to the hypotheses posed in the methodology section are discussed. Work constraints and major implications for local politics are also included in that portion.

2. Literature review

The objective of this section is to support the choice of variables and the construction of hypotheses. Since our work presents the issue of waste management expenditure in the framework of LA21, this segment will put forward two different perspectives. The first one will be focused on those aspects related to the implementation of LA21 sustainability objectives. The second part will address the specific subject of solid waste management in Spain and its different models of management.

Most works studying the development of LA21 in different geographical environments focus on analysing the implementation strategies of the Agenda at the local level. Sustainability as defined by the Brundtland Commission is an ambitious policy target. Environmental, economic, social, and institutional criteria are all considered to be of equal importance. Because of this complexity, the first step of the LA21 process should be to develop a vision of a sustainable society based on indicators to measure its progress (Valentin and Spangenberg, 2000).

For instance, Adolfsson (2002) studied four small- to medium-sized municipalities in Sweden and concluded that LA21 is a significant reinforcement for the development of appropriate natural resource management at the local level. We encountered other works in a similar vein [(Foh Lee, 2001), (Rutherford, Blackburn and Spence, 2000), (Eckerberg and Forsberg, 1998)].

Another widely explored perspective for the LA21 analysis that focused on the measurement of sustainable development outcomes pointed out that there is little evidence to indicate the effectiveness of these policies [(Poveda and Lipsett, 2011), (Thomas, 2010)]. Along this line of research, a realistic counterpoint emphasising problems of LA21 assessment was offered by Lafferty and Eckerberg (2013).

With regard to specific and integrated strategies for sustainability assessment, we also found several recent papers [(Devuyst, 1999), (Haapio and Viitaniemi, 2008), (Lawrence, 1997), (Nijkamp and Pepping, 1998), (Papadopoulos and Giama, 2009), (Cole and Valdebenito, 2013), (González, Martín, and Fernández, 2004)].

The study «Review of implementation of Agenda 21 and the Rio Principles» (2012) offers a detailed review of progress in implementation of LA21 from an international perspective. It shows that progress has been uneven and, despite some elements of good practice, most LA21 outcomes have not yet been achieved. Nevertheless, regarding our main interest in this work, LA21 has been one of the most extensively followed up programmes from the United Nations Conference on Environment and Development (UNCED) and is widely cited as an unprecedented success in linking global goals to local action. Still, the progress so far does not mean that the work is over. In this regard, multi-level governance is a general recommendation, as well as increased integration between local authorities and multi-stakeholders in their communities (Stakeholder Forum for a Sustainable Future, 2012).

Regarding the implementation of LA21 in Spain, several recent studies provide a nearly complete picture of the situation [(Font and Subirats, 2000), (Hernández, 2003), (Echebarria, Barrutia and Aguado, 2004), (Moralejo, Legarreta and Miguel, 2007), (Hidalgo, 2008), (Martínez and Rosende, 2011), (Observatorio de la Sostenibilidad, 2014), (Jiménez, 2008)].

In Spain, the Sustainable Development Strategy was introduced by the Government in June 2000. It included the commitment to promote a new model of integration and the balancing of economic, social development and environmental protection in the long term.

Most cities that have started the implementation of LA21 contain between 5,000 and 50,000 inhabitants. Yet the participation of counties and town associations makes the adhesion to LA21 possible for many little towns as well. In addition, it should be highlighted that a great number of municipalities that adhered to LA21 are big cities like Barcelona, Madrid, Málaga, Sevilla, etc. In all cases, one of the most frequently used objectives in LA21 action plans has been oriented to urban solid waste management.

The demands of rural and urban municipalities are clearly different. The former show major lacks in areas such as public transport, urban facilities and services accessibility, plus labour market. Alternatively, the latter have a greater need for environmental traffic control, waste management, or housing access (Hidalgo, 2008).

Regarding the environmental expenditure, we would like to point out the relevance of the work by Aguado and Echebarria (2004) in which they analysed the situ-

ation of the Spanish regions concerning budgetary expenditure intended for various environmental items. Their hypothesis tries to demonstrate the great influence that environmental spending has in implementing LA21. Concretely, they analysed 11 groups of environmental expenditures. One of these groups is related to waste management expenses. That study mentions Cantabria and La Rioja as the two Spanish regions with more per capita expenditures for waste management. In addition, their work raises some doubts about the coherence between the political commitment to the Charter of Aalborg and the actual economic support for the implementation of local strategies oriented to sustainable development.

In this paper, our interest is focussed on the idea that the municipalities implementing LA21 have more intense environmental awareness and greater expenses for solid waste management (Kveton, Louda, Slavik and Pelucha, 2014). Within this area of research, Lima, *et al.* (2012) analysed the determining factors in the development of environmental management practices, such as solid waste management. The explanatory factors utilised were the size of the municipality, the adoption of proactive environmental strategies, and the implementation of LA21. The authors maintain that there is a positive relationship between the size of the municipality and the degree to which the local administration develops environmental management practices. Accordingly, Fidélis and Pires (2009) also concluded that the size of the municipality is an element that explains the degree of development of environmental management practices.

As a further factor, the Spanish Constitution establishes that minimum mandatory services must be provided by local administrations, although this does not imply that they have to be carried out internally. For this reason, privatisation is increasingly used in the management of local public services, including solid waste management (Vickers and Yarrow, 1991). Depending on greater or less private partners' participation, privatisation can adopt different forms— mixed public and private production, which has been widely used in the United States (Warner and Hefetz, 2008); inter-municipal cooperation, to achieve scale economies [(Bel and Costas, 2006), (Warner and Hefetz, 2003)]; and outsourcing, which is most commonly used in Spain and, in general, in Europe.

As a rule, the choice of one privatisation model or another is not ideological, but pragmatic. Before making a decision, local governments must manage factors like cost reduction, political interest, fiscal constraints, market competition and interest groups [(Bel and Miralles, 2003), (Bel and Fageda, 2007), (Bel and Fageda, 2008), (Bel and Fageda, 2009)]. The relative importance of these elements can vary significantly, depending on whether the municipality is small or large. In any case, the importance assigned to the influencing factors is very sensitive to the characteristics of the particular study (Bel and Fageda, 2009).

Bel (2006) performed a multivariate analysis to determine if the form of production of solid waste management service (public or outsourced) has any influence on municipal expenditures. Other research has shown ambiguous evidence in this regard, with respect to the existence of economies of scale, density or scope

[(Hirsch, 1965), (Kitchen, 1976), (Stevens, 1978), (Dubin and Navarro, 1988), (Callan and Thomas, 2001)]. Only a few studies have found significant scale economies in municipalities with less population [(Dubin and Navarro, 1988), (Bel, 2006)]. Although it is argued that the manner of production (public or private) does not influence the costs borne by the municipalities [(Callan and Thomas, 2001), (Bel, 2006), (Bel and Costas, 2006), (Ruiz-Villaverde, González-Gómez and J. Picazo-Tadeo, 2015)], some investigations indicate ambiguity. All studies, except that of Stevens (1978) which includes production cost information, use the concept of cost of service to refer to the municipal budget for the service payment. Therefore, we consider it more expedient to use the full coverage concept of municipal expenditure.

One of the main objectives sought with privatisation of the service is the cost savings. Two main reasons justify this relationship. Firstly, privatisation introduces competition where before there was a public monopoly. Costs reduction will be greater in those large cities where there is greater availability of external providers. Hence, large cities tend to privatise services more, while small ones often opt for outsourcing to public agencies. A second reason lies in the possibility of exploiting scale economies, especially important in small cities (Bel and Fageda, 2008). But the literature does not offer a clear relation between privatisation and cost savings [(Bel and Warner, 2008), (Bel and Mur, 2009)]. While initial research shows a saving in costs, this is not the case in more recent studies. One explanation would be that privatisation does not entail cost savings if there is no competition, a case that usually occurs when a public monopoly is replaced by a private one [(Bel and Warner, 2008), (Warner, 2010)]. This circumstance focuses the debate on the transaction costs and regulations (Bel, Fageda and Warner, 2010).

Neither the public nor private production of the service has proved to be a perfect option. Hence many municipalities prefer mixed forms that provide greater flexibility. In rural areas and small municipalities, inter-municipal cooperation has been used as an alternative to privatisation in order to achieve scale economies [(Bel and Costas, 2006), (Warner and Hefetz, 2003), (Warner and Hefetz, 2008), (Bel, Fageda and Mur, 2013)]. Bel and Fageda (2006) analysed how inter-municipal cooperation between small municipalities can be an alternative, so as to offer local services efficiently.

Other local governments use partial privatisation, through a public-private joint venture, when cost, financial constraints, and private interests exert contradictory pressures. In Spain, private partners are often large companies with a market reputation. They develop the functions associated with the service, but the government maintains the control of activities thus reducing transaction costs [(Bel and Costas, 2006), (Warner and Bel, 2008), (Bel and Fageda, 2010)]. Public-private joint ventures are also positively associated with inter-municipal cooperation. Bel and Fageda (2010) conclude that there is an inverse U-shaped relationship between the size of the municipality and the decision to partially privatise a service. According to the authors, ideological and political factors have no influence on the decision to use a joint venture.

Another form of privatisation is the use of outsourcing, which allows the local administration to maintain ownership and responsibility in the public service, although production is performed by an external agent (public or private). This privatisation implies a lower budget contribution to the financing of the service by the municipality, which usually entails an increase in the fees paid by users (Bel, 2002).

Bel and Miralles (2003) and Bel, Fageda and Mur (2010) found a significant relationship between the demand for solid waste management, or the population of the municipality, and the decision to outsource the service. However, a clear relation between privatisation and size of the municipality has not been observed. Neither was statistical evidence found to support the relationship between local budget restrictions and the outsourcing decision, perhaps because this type of outsourcing does not generate direct revenues for the administration [(Bel and Miralles, 2003), (Bel, Fageda and Mur, 2010)].

In summary, efficiency and pragmatic motives have a greater influence on outsourcing decisions than ideological goals. In this context, Bel, Fageda and Mur (2010) did not find a significant relationship between the political party that governs the corporation and outsourcing decisions.

In any case, political factors and ideological attitudes have been considered in various studies [(Dubin and Navarro, 1988), (Bel and Miralles, 2003), (Bel and Fageda, 2007), (Bel and Fageda, 2008)], because not only can they influence privatisation, but also economic, social and sustainable development as well. It has been argued that parties with left-wing ideologies are more aware of sustainable development and social participation (Prado and García, 2009). Moreover, Bel and Fageda (2008) concluded that the municipalities that opted for privatisation were governed by conservative parties.

Albeit our approach ignores the issue of efficiency in spending, in Spain most of the projects considered to be examples of good practice (Federación Española de Municipios y Provincias-FEMP & Observatorio de la Sostenibilidad en España-OSE, 2013) are linked to relevant initial investments. This connection makes it reasonable to associate political commitment with environmental expenditure, and more specifically, with the variable «waste management expenditure».

Several findings from the literature served as inspiration for the hypotheses that we will test in this work and the choice of the variables:

- H1: The municipalities that adhered to LA21 experienced a greater increase of budgetary resources for expenditure functions related to waste management in absolute terms.
- H2: The municipalities that adhered to LA21 experienced a greater increase of budgetary resources for expenditure functions related to waste management in per capita terms.
- H3: The municipalities that adhered to LA21 experienced a greater increase of budgetary resources for expenditure functions related to waste management with respect to their total budget.

- H4: The municipalities that adhered to LA21, with political tendencies towards the left, experienced a greater increase in the percentage of their budget devoted to expenditure functions related to waste management.
- H5: The impact of LA21 on the amount of budgetary resources that municipalities devote to waste management varies depending on their size.

3. Methodology

The geographic scope of this study, before the application of the exclusion criteria, covers 100% of the Spanish national territory. Regarding the temporal scope, the period covered is 2002-2012.

The quantitative analysis of this article is based on a database built from different sources, in which we have combined the data from the final budgets for 2002 and 2012, the population of each municipality for the years studied, the results of the municipal elections (1999-2011) and the ideology (L/R) of the political party that won the most votes in the municipal elections.

Regarding the budget, data have been obtained from the website of the Ministry of Finance and Public Administration (<http://serviciostelematicosext.minhap.gob.es/SGCAL/entidadeslocales/>). It is important to note that in 2008 there was a legislative change in the accounting rules of local governments that came into force in 2010. This change generates a difference of content in functional programs related to environmental expenditure between 2002 and 2012.

In accordance with the Order of September 20, 1989, by which the structure of the local budgets is regulated, we have identified one spending sub-function for the year 2002, which is «4.4 Community Welfare».

For this work, the variable waste management expenditure in 2002 corresponds with the costs incurred by the municipalities in the program «4.4.2 Waste collection and street cleaning».

After 2010, a new sub-function was included in the functional classification of local budgets, the 17th policy «Environment» (Order EHA / 3565/2008, December 3rd). But, specifically for waste management, the 16th policy «Community welfare» includes two programs: 162 «Collection, disposal and treatment of waste» and 163 «Street cleaning».

Therefore, the waste management expenditure is taken from the functional classification of municipal budgets, by reference to the program 442 for 2002 and the sum of the programs 162 and 163 for 2012.

Data related to electoral consultations in recent legislatures were obtained from Consultation Election Results of the Ministry of Interior for 1999, 2003, 2007 and 2011 (<http://www.infoelectoral.interior.es/min/areaDescarga.html?method=inicio>).

In total, a database was designed with 11,857 records corresponding to those of local authorities that are in the budget database of the years 2002 and 2012. From this

whole, a sample of 6,502 municipalities was selected. To choose this sample, we applied two exclusion criteria that prevent those municipalities lacking a budget in 2002 or in 2012 and local government entities without associated population (Councils, Commonwealths, Counties, etc.) from being considered.

The experimental group was initially composed of 161 Spanish municipalities that in 2002 had adhered to the LA21¹. Finally, after we applied the exclusion criteria, 6,502 municipalities were included in our study sample, of which 149 belonged to the experimental group (LA21) and the remaining 6,353 to the control group.

Within each group, we distinguished two divisions of municipalities by population size—the group of small sized municipalities and the group of medium and large sized municipalities. That separation was accomplished by taking the median population of the whole sample as the limit for each group.

Table 1 provides information on the coverage of the sample with respect to the number of municipalities and population, as well as to waste management expenditure (in absolute terms, per capita, and in percentage over the whole budget).

Table 1. Description of the sample

	<i>No. Municipalities</i>	<i>No. Inhabitants</i>	<i>Avg. Waste Expend. (€)</i>	<i>Avg. Waste Expend. (€/inhab.)</i>	<i>Avg. Waste Expend. (%)</i>
Year 2002	6,502	39,484,149	345,619.69	25.83	2.91
Control Group	6,353	24,030,807	171,068.95	25.03	2.83
Small Mun.	3,251	864,501	5,554.42	20.87	1.98
Large Mun.	3,102	23,166,306	344,533.73	29.40	3.72
Experimental Group	149	15,453,342	7,788,041.52	59.95	6.51
Large Mun.	149	15,453,342	7,788,041.52	59.95	6.51
Year 2012	6,502	44,634,760	650,948.04	23.23	2.33
Control Group	6,353	27,786,938	346,029.23	21.39	2.16
Small Mun.	3,251	876,791	2,331.02	5.88	0.42
Large Mun.	3,102	26,910,147	706,236.48	37.65	3.99
Experimental Group	149	16,847,822	13,651,949.41	101.66	9.54
Large Mun.	149	16,847,822	13,651,949.41	101.66	9.54

Source: Own elaboration with data extracted from Ministry of Finance and Public Administration (<http://servicios-telematicosextr.minhap.gob.es/SGCAL/entidadeslocales/>).

¹ Data obtained from the study of Hernández Aja, A. (2003). According to this study, 409 municipalities had signed the Aalborg Charter by 2002. 189 municipalities confirmed their commitment to the Aalborg Charter in a survey. 149 of them appear in our database with environmental costs in their budgets.

Between 2002 and 2012, waste management expenses experienced a significant increase, but this rise was concentrated in medium and large sized municipalities. The different strategies for waste management, which were noted in the literature (mixed public and private production, inter-municipal cooperation, and outsourcing), caused the decrease of the average waste management expenses in small towns in 2012. In addition, there are no small municipalities within the experimental group and all the biggest cities are included.

The coverage of the municipalities included in the sample exceeds 99% and 94% in terms of population in 2002 and 2012 respectively. The population contained in the experimental group represents 39% and 35% of the national population in 2002 and 2012 respectively.

In both years, municipalities included in the experimental group—which adhered to the LA21— show higher figures regarding waste management expenses per inhabitant and in relation to their whole budget.

In order to achieve the specific objectives and to test the hypotheses formulated, seven variables were utilised:

- Waste management expenditure (final budget) in Euros.
- Waste management expenditure (final budget) in EUR/Inhabitant.
- Waste management expenditure (final budget) in %/Total budget.
- Total budget expenditure (final budget).
- Population (number of inhabitants).
- Local governments policy trend.
- Population size of towns (related to the median and to the average value).

The first three are dependent variables that define three different models (M1, M2, and M3). The next three are the independent or explicative variables. And the last one is the variable used to segment the database and solve the previous models in a separate manner.

Given the great number of political parties, 1,391, that participated in the last four municipal elections, there was great difficulty in knowing the political affiliation of each municipal government. To simplify the analysis, we chose the ten political parties that obtained the most votes in a greater number of municipalities. These ten parties, because of coalitions between political parties produced during the period 2003-2011, have been reduced to seven (CiU, EAJ-PNV/EA, ESQUERRA-AM, IU, PAR, PP, PSOE).

The experimental group shows a great concentration of large municipalities. For this reason, population size of towns has been included in econometric models, so as to have a segmentation of results depending on the size of municipalities. Regarding the population size, all municipalities were classified according to their size in relation to the median and the average size of the sample in 2002.

For the treatment of data and application of statistical techniques, software packages, SPSS (Statistical Package for Social Sciences), SAS (Statistical Analysis Software) and Eviews 8 were used.

The econometric technique utilised to solve all models was Difference in Differences. The DiD method estimates the counterfactual change in the result for the treatment group by calculating the change in the result for the comparison group, which takes into account any constant difference over time between the two groups (Gertler, *et al.*, 2011). What is being applied in DiD models is the double differences. The first difference is calculated for the results of the experimental group before and after, that is, considering the constant factors over time for this group. But, to thoroughly observe the variable factors throughout the duration of time, we should also measure the change before and after the results in the control group that was exposed to the same conditions. This is the second difference.

Thus, the DiD method would combine the two false counterfactuals (before and after comparisons, and comparisons between experimental and control groups) in order to generate a better estimate of the counterfactual. This method does not require rules for the allocation of individuals in the treatment group, but requires that the control group could represent a change in the results that the treatment group would have experienced in the absence of the program.

The Difference in Differences method (DiD) has been used widely when the evaluation of a given intervention entails the collection of panel data or repeated cross sections. DiD integrates the advances of the fixed effects estimators with the causal inference analysis, when unobserved events or characteristics confound the interpretations (Angrist and Pischke, 2009).

Despite the existence of other plausible methods based on the availability of observational data for quasi-experimental causal inference —i.e., matching methods, instrumental variable, regression discontinuity— DiD estimations offer a beneficial alternative, reaching the unconfoundedness by controlling for unobserved characteristics and combining them with observed or complementary information. Additionally, the DiD is a flexible form of causal inference, because it can be combined with some other procedures, such as the Kernel Propensity Score and the quintile regression (Villa, 2012).

For the econometric assessment of the impact of the LA21 on waste management spending, the next base regression is used (Pérez and Moral, 2015):

$$Y = a_0 + a_1G + a_2T + a_3G \times T + b_1X_1 + b_2X_2 + e \quad [1]$$

where,

Y is the waste management expenditure.

G is the dummy variable that distinguishes the group (treatment or control).

T is the dummy variable defining the baseline and the endline.

$G \times T$ is the interaction between the dummy variables G and T .

X_1 is a control variable corresponding to Total Budget.

X_2 is a control variable corresponding to Population.

e represents the error term.

The $G \times T$ estimated coefficient, a_3 , is the statistical representation of difference in differences, which assesses the impact of LA21 on waste management spending.

The dependent variable (Y) will take three different forms— the waste management expenditure in absolute terms (Euros) (M1), in per capita terms (EUR/inhabitant) (M2), and in percentage of the whole budget (M3).

In addition to the previous main model, two fixed effects panel data models were built. One was according to Autonomous Communities and the other by political character of local governments. As a consequence, in addition to estimating and evaluating the impact of LA21 on waste management expenditure, comparisons could also be made between regions and between options within the political spectrum.

To reinforce the consistency of the results obtained through the DiD models, these models have been subjected to some stress tests. Firstly, the control variables included in the models are stressed. For that, the M1 model will be solved in three alternative formats— not including control variables, including only the per capita budget, and including budget and per capita income. Secondly, the control group is stressed. So as to find the counterfactual closest to the experimental group, only those municipalities with more than 10,000 inhabitants are included in the model. With this population limit, the experimental group and the control group are reduced to 137 and 502 municipalities, respectively.

4. Results

The results of the estimates were verified by statistical software packages mentioned in the methodology section. All estimates have undergone the appropriate tests to verify that the required assumptions (normality of residuals, heteroskedasticity, multicollinearity, no correlation of disturbances) were met, as well as the various criteria that inform about the predictive capacity of the models (Table 2).

Table 2 shows the results of three different models (M1, M2, M3) as regards three groups of municipalities ($Y1$, $Y2$, $Y3$). The first group refers to all municipalities included in the sample; the second one only contains those municipalities with a population size less than the average; and the third one simply includes municipalities with a population size equal to or larger than the average. Initially, we tried to make the segmentation of the sample according to the median population size of municipalities. But results were not coherent with the fundamentals of DiD models, because all municipalities smaller than the median were in the control group and none in the experimental group. Thus, models $Y2$ and $Y3$ could be considered a sensitivity analysis with respect to the model $Y1$.

Taking into account the whole sample, results are very clear and ratify our hypotheses H1, H2, and H3. The coefficients of the variable $G \times T$, representing the interaction between the two dummy variables of the model (G and T), are positive and statistically significant. Thus, it is confirmed that municipalities adhering to LA21

Table 2. Difference in Differences Models

	<i>Y1: Waste Management Expenditure</i>								
	<i>M1: EUR</i>			<i>M2: EUR / Inhabitant</i>			<i>M3: % / Total budget</i>		
	<i>Coefficient</i>	<i>T</i>	<i>Sig (p value)</i>	<i>Coef-ficient</i>	<i>T</i>	<i>Sig (p value)</i>	<i>Coef-ficient</i>	<i>T</i>	<i>Sig (p value)</i>
Intercept	-180587.889	-9.346	0.000	24.670	45.765	0.000	2.751	57.501	0.000
G: LA21 (1) vs non-LA21(0)	-2665335.911	-20.114	0.000	25.637	6.935	0.000	1.939	5.911	0.000
T: After (1) vs before (0)	61555.686	2.261	0.024	-3.679	-4.845	0.000	-0.662	-9.829	0.000
<i>G × T: Interaction term</i>	2231729.376	12.275	0.000	45.193	8.910	0.000	4.412	9.802	0.000
Total Budget	0.092	87.753	0.000	0.000	-0.813	0.416	0.000	-12.052	0.000
Population	21.634	17.907	0.000	0.000	3.379	0.001	0.000	15.065	0.000
Model Summary	DW: 2.002		0.000	DW: 1.900		0.000	DW: 1.900		0.000
Adjusted R-squared	0.945			0.054			0.079		

	<i>Y2: Waste Management Expenditure in Small Municipalities</i>								
	<i>M1: EUR</i>			<i>M2: EUR / Inhabitant</i>			<i>M3: % / Total budget</i>		
	<i>Coefficient</i>	<i>T</i>	<i>Sig (p value)</i>	<i>Coef-ficient</i>	<i>T</i>	<i>Sig (p value)</i>	<i>Coef-ficient</i>	<i>T</i>	<i>Sig (p value)</i>
Intercept	-21519.899	-16.987	0.000	16.574	31.382	0.000	1.646	37.122	0.000
G: LA21 (1) vs non-LA21(0)	-41626.288	-1.303	0.193	-7.295	-0.548	0.584	-0.582	-0.520	0.603
T: After (1) vs before (0)	-2843.022	-1.758	0.079	-12.553	-18.616	0.000	-1.350	-23.849	0.000
<i>G × T: Interaction term</i>	30773.295	0.681	0.496	15.269	0.811	0.417	1.992	1.260	0.208
Total Budget	0.050	46.567	0.000	0.000	31.799	0.000	0.000	7.668	0.000
Population	4.118	3.953	0.000	-0.006	-14.650	0.000	0.000	12.977	0.000
Model Summary	DW: 2.019		0.000	DW: 1.953		0.000	DW: 1.920		0.000
Adjusted R-squared	0.483			0.146			0.159		

	<i>Y3: Waste Management Expenditure in Medium-Sized or Large Municipalities</i>								
	<i>M1: EUR</i>			<i>M2: EUR / Inhabitant</i>			<i>M3: % / Total budget</i>		
	<i>Coefficient</i>	<i>T</i>	<i>Sig (p value)</i>	<i>Coef-ficient</i>	<i>T</i>	<i>Sig (p value)</i>	<i>Coef-ficient</i>	<i>T</i>	<i>Sig (p value)</i>
Intercept	-930064.995	-6.487	0.000	44.667	24.672	0.000	5.500	35.267	0.000
G: LA21 (1) vs non-LA21(0)	-2191224.522	-5.893	0.000	16.820	3.582	0.000	0.552	1.365	0.172
T: After (1) vs before (0)	620207.246	3.117	0.002	33.267	13.238	0.000	2.928	13.528	0.000
<i>G × T: Interaction term</i>	1857777.929	3.590	0.000	5.928	0.907	0.364	0.401	0.712	0.476
Total Budget	0.090	32.189	0.000	0.000	3.647	0.000	0.000	-3.018	0.003
Population	25.442	7.916	0.000	0.000	-2.741	0.006	0.000	3.925	0.000
Model Summary	DW: 2.012		0.000	DW: 2.005		0.000	DW: 2.009		0.000
Adjusted R-squared	0.945			0.139			0.122		

Source: own elaboration.

devote more budgetary resources to waste management in absolute terms, in per capita terms, and in terms of percentage of their whole budget.

After the segmentation of the sample regarding the average population size, all coefficients for the $G \times T$ variable were positive but not statistically significant, except for Medium-Sized or Large Municipalities, when the measurements of budgetary resources devoted to waste management were taken in absolute terms. This model based on expenses in absolute terms (M1) ratified the hypothesis H5, because the variable $G \times T$ is statistically significant only for Medium-Sized or Large Municipalities. Thus, the adherence to the LA21 has a positive effect on the budgetary resources devoted to waste management in large municipalities but not in small ones.

The results of the stress tests on the M1 model confirmed the results obtained in the original models, that is, the positive sign and the statistical significance of the variable $G \times T$. However, by including in the model only those municipalities with more than 10,000 inhabitants, the results are weakened; the $G \times T$ variable still has a positive sign and is statistically significant, but only at a level of 10%. These results confirm the high sensitivity of the model to the population size of the municipalities included in it, as can be seen from the segmented models Y2 and Y3.

Based on the whole sample of municipalities, a fixed effects panel data model was adjusted, including the Spanish Autonomous Communities as factor (Table 3).

The fixed effects models ratify the sign of parameters estimated in the DiD model (Y1) and their statistical significance, and this makes it possible to know the different effect that LA21 has had in each region.

Table 3 reflects the results obtained from the whole sample of municipalities. When we differentiate between small and medium/large sized municipalities, the results are similar to those presented in Table 3. Therefore, we only found positive effects of adhering to LA21 in the municipalities of medium or large size, when we took as a dependent variable the expenditure on waste management in absolute terms. In the other cases, we did not find positive and significant results.

Regardless of the selection of municipalities, in all cases Models 2 and 3 exhibit a more homogeneous picture regarding the influence of the different regions on waste management expenditures. In accordance with these models, municipalities from Melilla, Balearic Islands, Canary Islands, Murcia, Basque Country, and Catalonia stand out with significant and high positive estimates. The municipalities of these Autonomous Communities that adhered to the LA21 are the ones that have the greatest influence on the results of the general model.

The second fixed effects panel data model includes as a factor the political character of local governments. The political character of the right-wing municipalities (value 1) was a positive and significant variable, as were those of the other two trends [left (0) and centre (2)], but with the highest estimate value in Models 1 and 2. This fact indicates that this is the variable that exerts the greatest influence

Table 3. Fixed Effects Model 2002-2012 CCAA

	<i>Y1: Waste Management Expenditure</i>								
	<i>M1: EUR</i>			<i>M2: EUR / Inhabitant</i>			<i>M3: % / Total budget</i>		
	<i>Estimate</i>	<i>T</i>	<i>Sig (p value)</i>	<i>Estimate</i>	<i>T</i>	<i>Sig (p value)</i>	<i>Estimate</i>	<i>T</i>	<i>Sig (p value)</i>
<i>T: After (1) vs before (0)</i>	61443.101	2.266	0.023	-3.674	-5.292	0.000	-0.664	-10.815	0.000
<i>G: LA21 (1) vs non-LA21(0)</i>	-2701592.634	-20.292	0.000	8.568	2.513	0.012	0.641	2.129	0.033
<i>G × T: Interaction term</i>	2231660.402	12.321	0.000	45.086	9.720	0.000	4.302	10.496	0.000
Total Budget	0.092	86.869	0.000	0.000	-0.531	0.595	0.000	-11.030	0.000
Population	21.978	17.987	0.000	0.000	2.813	0.005	0.000	13.699	0.000
Andalucía	-384252.115	-8.414	0.000	27.988	23.930	0.000	3.452	33.402	0.000
Aragón	-181839.613	-3.758	0.000	14.932	12.050	0.000	1.407	12.851	0.000
Canarias	-547049.972	-4.654	0.000	59.788	19.860	0.000	5.992	22.524	0.000
Cantabria	-93314.219	-0.844	0.399	29.885	10.556	0.000	3.834	15.324	0.000
Castilla y León	-87441.882	-2.965	0.003	7.274	9.632	0.000	1.071	16.053	0.000
Castilla-La Mancha	-140319.955	-3.221	0.001	15.664	14.040	0.000	2.072	21.015	0.000
Cataluña	-101538.308	-2.558	0.011	48.402	47.621	0.000	4.567	50.851	0.000
Cdad. Foral de Navarra	-271086.423	-3.610	0.000	11.455	5.957	0.000	1.322	7.778	0.000
Comunidad de Madrid	-378338.517	-3.978	0.000	42.606	17.493	0.000	4.184	19.442	0.000
Comunitat Valenciana	-152176.586	-2.829	0.005	35.404	25.699	0.000	4.087	33.574	0.000
Extremadura	-173170.454	-2.768	0.006	24.816	15.487	0.000	3.287	23.214	0.000
Galicia	-300516.385	-4.422	0.000	24.356	13.994	0.000	4.021	26.145	0.000
Illes Balears	231695.516	1.661	0.097	106.003	29.672	0.000	9.709	30.756	0.000
La Rioja	-138617.148	-1.459	0.145	25.218	10.365	0.000	2.402	11.172	0.000
Melilla	-6607789.492	-6.082	0.000	164.947	5.929	0.000	9.252	3.763	0.000
País Vasco	-311350.677	-4.391	0.000	53.151	29.269	0.000	4.237	26.405	0.000
Principado de Asturias	-656846.588	-5.052	0.000	33.186	9.967	0.000	4.227	14.368	0.000
Región de Murcia	-325919.510	-1.942	0.052	57.268	13.324	0.000	6.649	17.507	0.000

Source: own elaboration.

on the overall increase in budgetary allocations for waste management. Nonetheless, model 3 indicates that municipalities with leftist political tendencies have a greater effect on waste management expenses in terms of percentage of the whole budget (Table 4).

Table 4. Fixed Effects Model 2002-12 Political parties

	<i>Y1: Waste Management Expenditure</i>								
	<i>M1: EUR</i>			<i>M2: EUR / Inhabitant</i>			<i>M3: % / Total budget</i>		
	<i>Estimate</i>	<i>T</i>	<i>Sig (p value)</i>	<i>Estimate</i>	<i>T</i>	<i>Sig (p value)</i>	<i>Estimate</i>	<i>T</i>	<i>Sig (p value)</i>
<i>T: After (1) vs before (0)</i>	61564.022	2.262	0.024	-3.679	-4.844	0.000	-0.662	-9.831	0.000
<i>G: LA21 (1) vs non-LA21(0)</i>	-2660427.027	-20.078	0.000	25.669	6.942	0.000	1.924	5.863	0.000
<i>G × T: Interaction term</i>	2232041.314	12.280	0.000	45.196	8.910	0.000	4.412	9.803	0.000
Total Budget	0.092	87.762	0.000	0.000	-0.817	0.414	0.000	-12.046	0.000
Population	21.638	17.914	0.000	0.000	3.380	0.001	0.000	15.064	0.000
Political Sign (0 - Left)	-216366.661	-7.856	0.000	24.497	31.874	0.000	2.883	42.275	0.000
Political Sign (1 - Right)	-144936.084	-6.207	0.000	25.053	38.450	0.000	2.681	46.381	0.000
Political Sign (2 - Others)	-221353.970	-6.215	0.000	23.836	23.985	0.000	2.713	30.766	0.000

Source: own elaboration.

Models 1 and 2 indicate that the effect of LA21 in waste management expenditures is greater in those municipalities governed by right-wing parties. Thus, the fourth hypothesis cannot be confirmed, although the descriptive results indicate a greater increase of environmental expenses in municipalities that adhered to LA21 and were governed by leftist parties. As regards this conclusion, the composition of the sample plays a determinant role. 49 out of 52 Spanish capital provinces are included within the sample. And 35 out of 49 capital provinces included in the sample are governed by a right-wing political party. These largest cities concentrate 65.77% of population of the experimental group and 25.74% of the whole population included in the sample. So, the political trend resulting from the model is clearly determined by these 35 elements of the sample.

5. Conclusions

The research question that motivates this work arises from specialised literature on environmental issues and relates to the genuineness of the political commitment to the environmental objectives of those local governments that adhered to the LA21. The functional scope was limited to waste management, and political commitment was measured through the variation in budgetary resources allocated for that function. Our main data source is the publication of the Spanish local budgets implementation (execution) by the Ministry of Finance and Public Administration for the years 2002 and 2012. The geographic scope of the work covers the entire national territory and the unit of analysis is the municipalities.

Regarding the econometric methodology, the difference in differences models that we utilised included as control variables the population of the municipalities and

their total budgets. In this way, the models, by comparing two groups of municipalities, were able to verify whether municipalities that adhered to the LA21 increased their budgetary expenditure on waste management more than those that did not.

The population size of municipalities included in the models is determinant for the confirmation of the hypotheses formulated. With the whole sample of 6,502 municipalities, most of the original hypotheses have been corroborated. The results show that the municipalities that adhered to LA21 devoted more budgetary resources to expenditure functions related to waste management. But the verification of the first three hypotheses is weak, because it is sensitive to the size of municipalities included in the sample and to the variable used to measure the waste management expenditure.

In general, the population, the total budgetary expenditure and the political character of the municipalities exerted a significant influence on the evolution of waste management expenditure. In those municipalities that adhered to LA21 and were governed by left-wing parties, the percentage of their budget devoted to waste management is the highest.

Some methodological limitations of this study should be noted, although in our opinion, in no case did these limitations cast doubt on the validity of the results. The first one relates to the modification of accounting methodology for local entities. This change caused a break in the time series of environmental spending. However, since this circumstance affected all municipalities, we consider that this does not invalidate or limit the reliability of the DiD analysis carried out.

The second one involves the political character of local governments. Since no official statistics are available regarding the political parties of the mayors who governed the Spanish municipalities in the years 2002-2012, to calculate the political tendency of municipal governments, we used the statistics resulting from the elections of 1999-2003-2007 and 2011. The party that won the highest number of votes has been regarded as representing the political character of each electoral period.

Finally, the third limitation concerns the different levels of territorial governments that participate in waste management expenditures. This research focuses on the waste management expenses covered by decentralised budgets of local governments. Obviously upper tiers of governments at county, regional or national levels play an important, sometimes decisive, role in the whole waste management expenditure. But only local governments are the subject of interest in this particular study.

As an additional note, we consider it appropriate to clarify that the aim of this paper is not to evaluate the success of local governments in implementing LA21. We simply try to verify the causal relationship between LA21 adherence and the evolution of waste management spending during the period 2002-2012. For that reason, other determinant variables for environmental spending have not been included in the econometric models. The control variables contained in the models aim to eliminate the bias exerted by the largest municipalities, specifically when waste management expenditure is measured in absolute terms (M1). Nevertheless, as we have shown, size of municipalities is a crucial issue. Specifically, small municipalities are usually

involved in new strategies of waste management that are different from the traditional public provision of the service. These new managerial forms make it difficult to measure the resources devoted to waste management service, thus limiting the scope of this work.

As for the policy implications, it should be highlighted that increasing budgetary allocations for environmental expenditure in a period of economic crisis and budgetary constraints implies a high commitment to the objectives of LA21 in terms of promoting a model of sustainable development. With respect to the international context, we found some similarities in Norway. For one thing, Norway also devotes increasing amounts of economic resources for waste management. In addition, regarding the political commitment of those municipalities that adhered to LA21, the results of DiD models showed great sensitivity to the population size of municipalities, although this time in favour of small municipalities (Navarro *et al.*, 2016).

Finally, we wish to remark that the commitment to waste management of local governments adhering to the LA21 as well as their budgetary backing should be carefully handled. This is because methodological issues can lead to different conclusions. In concrete terms, the role of small and medium-sized municipalities and the influence of political character of local governments may vary, depending on the choice researchers make regarding how the measurement of waste management expenses is to be carried out—in absolute terms, in per capita terms, or as a percentage of the whole budget. Still, we believe that this study makes a meaningful contribution concerning the issue of whether political commitment to Local Agenda 21 is supported with action towards achieving the objectives of sustainable development through budgetary support for waste management policies.

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