SOCIO-ECONOMIC AND POLITICAL FACTORS AFFECTING THE RATE OF RECYCLING IN PORTUGUESE MUNICIPALITIES[1].

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Abstract:

Literature has mostly studied the impact of socio-economic factors on recycling, but little attention has been given to political factors as determinants of the recycling process in subnational units. This study analyses the impact of both socio-economic and political factors on the recycling process, based on a dataset of the Portuguese Municipalities in the period 2009-2017, assuming that political orientation and composition of the local government shapes also the recycling performance. By estimating a dynamic panel model, the results validate the U-shaped hypothesis between recycling and production activity, indicating that the primary sector is positively associated with recycling in contrast to other sectors, older population recycles more than young/middle age generation, and recycling increased during the fiscal consolidation period. Regarding the political variables, it is shown that political ideology of the local government (even when it is composed by independent groups of citizens) does not influence recycling significantly, contrary to expectations. Recycling declines in election years, and it is less when the executive in the Town Council and the Municipal Assembly share the same political ideology, validating the veto player theory. Evidence also suggests that the recycling behavior adjusts quickly to its desirable level reflecting a fast-learning process.

JEL classification: C33, D72, Q53, R11

Keywords: recycling, socio-economic characteristics, political structure, panel data, Portuguese municipalities.

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1. INTRODUCTION

The conflict between economic development and environmental protection has been an open issue, at both the country-level and community-level within a country. Several measures are taken by the local authorities to preserve the environment, and among them is waste management and recycling. Countries or sub-national entities have the responsibility to implement an efficient waste management policy and develop recycling programs to protect the environment from further degradation. Reducing the amount of waste produced and raising the proportion of recycled waste are two important steps toward the circular economy, against the conventional linear economic development strategy, and focus should be given to the Sustainable Development Goals as declared by the UN (United Nations, 2016). Municipal solid waste and recycling activities have been put at the center of local policies due to increasing complexity of these services stemming from growing cities and high service costs. Consequently, understanding the determinants of waste collection and those of recycling activities is a valuable matter for achieving the goals of environmental sustainability.

Although socio-economic factors have been analyzed extensively in the literature to explain waste generation and recycling activities, few studies have been conducted to understand the effects of political factors on waste and recycling performances. Political aspects of the ruling local authorities can influence the adoption of green policies, and this is the focus of this research which analyses the relationship between the local government ideology and recycling performance. While the relationship between political ideology and environmental quality has been studied broadly at the country-level (for a review see a recent study by Wen at al., 2016), studies examining the impact of political ideology on recycling activities at the municipal level are scarce. Consequently, this study attempts to fill such gap in the literature.

The main objective of this research is to examine the factors affecting recycling performance. The factors examined are divided into two groups: socio-economic characteristics, such as gross value-added per head, production structure, population age structure, population density, development level, and the impact of fiscal consolidation periods; and political factors, such as political cycle (elections), political ideology of the local government, political status of the ruling authority (ruling with majority, minority or coalition), and whether the Town Council (the executive branch) and the Municipal Assembly (the deliberative branch) are of the same ideology. We should note that in the

Portuguese municipalities there are no specific policies (such as garbage fee, recycling incentives, deposit refund for recyclables or other recycling schemes) to test their effectiveness on recycling, other than intensity of curbside collection. Furthermore, this intensity is difficult to be accounted for, as local budgets do not provide enough information on the financial effort devoted to specific policies on recycling, so we have to rely on political variables to measure their impact on recycling performance.

To assess the importance of these variables for the recycling activities we estimate a dynamic panel data model using a dataset of 305 Portuguese municipalities[1] covering the period 2009-2017.

The paper is divided into the following sections: after the introduction, Section 2 offers a brief review of the existing literature that analyses the determinants of recycled waste, focusing on the socio-economic and political characteristics; Section 3 describes the variables used in the empirical analysis and provides descriptive statistics on the data; the structural model to estimate and methodology are addressed in Section 4; the empirical results are presented in Section 5 discussing their implications; finally, Section 6 concludes the study by summarizing the main findings.

2. BACKGROUND AND EMPIRICAL FINDINGS

Urban waste generation in industrialized economies increased exponentially and this exerts a significant pressure on waste management (Buclet, 2000). Consequently, alternative waste treatments were researched in view of reorganizing waste disposal and reuse of a significant part of waste by introducing new schemes of recycling processes (Rostirolla and Romano, 2011). The emerging empirical literature on recycling can be divided into two main groups: the first explores data at the household-level and aims to identify the micro-factors and specific actions that influence recycling decisions (Ercolano et al. 2014); the second involves contributions that use aggregate data (municipal, regional or county-level data) to identify the factors that characterize local territories and influence recycling performance (Gaeta et al, 2017). The current study is part of this second group, focusing on aggregate factors to explain the recycling behavior of the Portuguese municipalities. However, we should note that these two levels are

[1] Portugal has a total number of 308 municipalities, but due to missing data the sample is reduced to 305 sub-national units.

highly interrelated, since municipal, regional or country level policies will affect the individual´s decisions to participate in the recycling process. On the other hand, the results obtained from the aggregate data on recycling are the outcome of the collection of individual behaviors.

The literature considering community-level data has suggested that recycling is influenced by a variety of socio-economic and demographic factors, such as income, education level, employment status, age, population density, migration, household size or production structure, and specific policies aiming to reduce waste and promote recycling activities. Among these studies, less attention has been given to the political factors as determinants of the recycling behavior and one of the objectives of this paper is to fill in this gap.

With respect to socio-economic and demographic factors, Kinnaman and Fullerton (2000) used cross-sectional data for more than 900 U.S. communities and found that recycling increases with the proportion of retired people and family size, while population density has a negative effect. Later studies found conflicting results regarding these variables: Sidique et al. (2010) examined the effect of policy, income, and demographic variables on the rate of recycling in Minnesota using county panel data over the period 1996-2004. They confirmed that recycling increases with age, while population density has no effect on the recycling rate and income has a negative impact. Abbott et al. (2011) considered a sample of 434 regional quarterly data for the U.K. over the period 2006-2008 and found that population density is positively correlated with recycling, while neither income nor household size are important. Terry (2011) using annual data from 1960 to 2000 for the US municipalities found that neither income nor household size are important factors, while age (contrary to what was found in previous studies) influences the recycling rate negatively.

More recently, some studies have established a positive relation between income and recycling rate. Romano et al., (2019), using municipal data of the Tuscany region in Italy over the period 2012-2015, showed that recycling levels are higher in municipalities with higher per capita income and population density, while Valenzuela-Levi (2019a), using panel data for Barcelona and London, found that income affects positively the recycling rate with no evidence supporting the environmental Kuznets (1955) curve.

On the same subject, some other studies found no significant association between socio-economic and demographic factors and the recycling rate. Among them, is the study

by Valenzuela-Levi (2019b) using a panel dataset (through a survey process) that covers the 2013-2017 period for 42 municipalities in Chile or the study by Hage et al., (2018) using cross-sectional data for 282 Swedish municipalities.

Overall, previous studies found conflicting results regarding the socio-economic and demographic factors affecting recycling, which calls for further research. Moreover, most of the studies, and contrary to the environment protection literature, have not considered political factors as determinants of recycling, with few exceptions such as the studies by Hage et al. (2018) and Gaeta et al. (2017). The first tested the influence of environmental preferences in the municipal government according to the presence of the Green party in the government, and the environmental preferences of households (measured as the share of votes received by the Green party in the elections for the parliament). Both variables were found to be statistically insignificant. The second study, from Gaeta et al. (2017), considered a cross-section municipal dataset from the most populated and wealthier region of Lombardy in Northern Italy. They tested whether political competition motivates recycling performances, but the impact was not statistically significant.

The fact that little importance has been given to political factors to explain recycling performance opens an avenue for further research. Benton (1977) argued that right-wing ideology attaches greater importance to economic performance than to the environment, while left-wing parties pay more attention to environmental quality. This idea is linked with the early partisan theory developed by Hibbs (1977) and the rational partisan theory supported by Alesina (1987) that left-wing parties implement policies to support the working class and their wellbeing, while right-wing parties adopt policies to control inflation and promote growth. Therefore, government ideology could affect the environmental performance through its impact on economic development.

Furthermore, other features of local authority can be related to institutional constraints and to two competing theories: the veto theory supported by Tsebelis (1995 and 2002) and the consensus approach sustained by Lijphart (1999). The first claims that the absence of ideological alignment between the different ruling bodies can create more institutional constraints, making it more difficult to adopt environmental policies. The second view admits that the need for consensus delivers more power to diffuse groups, increasing therefore the probability to promote more active recycling policies.

Regarding the literature on environment protection and the political factors, Neumayer (2003) provides evidence for the OECD countries that pollution levels are lower when left-wing and liberal parties have governing strength, concluding that left-wing parties are more pro-environment. Jensen and Spoon (2011), using data for 15 European countries, show that pro-environment governments and Green parties in office managed to reduce the gap between actual greenhouse gas emissions and the target set by the Kyoto Protocol. The results provided by Aklin and Urpelainen (2013) considering a group of 28 countries indicate that the share of renewables in electricity generation increased when the government shifted from right-wing to left-wing and decreased when the shift went in the opposite direction. Garmann (2014), considering a sample of 19 OECD countries over the period 1992-2008, showed that the growth rate in carbon dioxide emissions was lower when left-wing governments were in office.

In the same vein, Wen et al. (2016) looked into the relationship between government ideology and environmental quality, using panel data of 85 countries over the 2002-2012 period. They provide evidence that left-wing governments award greater importance to environmental quality than to economic performance, while right-wing governments care more about economic growth than about environmental problems. They also found that parties with green ideology and anti-growth identity exhibit better environmental performance, including the Christian democratic parties in the group of the OECD countries.

A more encompassing study considering the relationship between the environment and political factors was conducted by Knill et al. (2010), using the ENVIPOLCON data[2] for 18 OECD countries and considering four specific years (1970, 1980, 1990 and 2000). They found that the existence of an environmental minister, more parties with environmental concerns and left-wing parties in the government increase the number of environmental policies adopted. Regarding institutional constraints, they confirmed the veto player theory advocated by Tsebelis' (1995, 2002) and not the consensus approach by Lijphart's (1999), so institutional constraints hinder the adoption of environmentally-friendlier policies.

With respect to the behavior of consumers, Minton and Rose (1997) found that environmental concern is positively related to recycling and the choice to consume

[2] Holzinger et al. (2008a, b)

environmentally friendly products. Cruz (2017) researched the relationship between environmental concern and political party affiliation, and political ideology, based on a meta-analysis. He concluded that both political standings have a positive association with environmental concern, but the relationship with political ideology is stronger. Additionally, the relationship between political beliefs and environmental issues increases with education.

The evidence of the factors determining the recycling performance, as seen above, is controversial and not universal, and studies considering sub-national data are limited. Furthermore, there is little evidence of the impact of political factors that explain recycling behavior. The present study aims to fill in these gaps, bringing new evidence on this topic by considering the recycling performance of Portuguese municipality units from 2009 to 2017. The contribution of the study consists of analyzing, first, the impact of socio-economic factors on recycling performance of Portuguese municipalities. The set of socio-economic variables includes waste production, overall gross value-added serving as indicator of economic activity, the shares of sectoral production, population age structure, population density, and a dummy variable to test the effect of the fiscal consolidation period 2011-2014 on recycling behavior across municipalities. Second, after validating the importance of the socio-economic factors, the set of political variables is introduced into the model to test their relevance on recycling performance. These variables characterize the political orientation of the local governing authority, whether right-wing or left-wing or independent ideology, whether the local executive has a majority or it is a coalition of different parties, and whether the Town Council and the Municipal Assembly are of the same ideology (Alignment). We have also tested for effects of the political cycle (election years) on the recycling policy of municipalities. Third, dynamic aspects are introduced into the model to test if past levels of recycling are important for explaining current levels. Fourth, non-linear relationships between recycling and waste and between recycling and the production level are tested to determine the shape of these relations and whether a turning point exists in these performances. All of these aspects considered, and to the author's knowledge, this is the first study that attempts to evaluate the impact of both socio-economic and political factors on the recycling performance at this level of breakdown.

3. VARIABLES DEFINITION AND DESCRIPTIVE STATISTICS

The variables considered in this paper can be divided into two main groups: those related to socio-economic factors and those which describe political characteristics. These two sets of variables are explained in detail in Table 1. In particular, *RECpc* denotes the recycling level measured in tons per capita; *MWGpc* means the level of municipal waste generation measured in the same unit (tons per head); *GVApc* stands for gross value-added per head (of non-financial sectors) and it is used as a proxy for economic activity; *GVA1*, *GVA2* and *GVA3* are the gross-value added shares of the primary, secondary and tertiary sectors, respectively, in each municipality; population density *PopDen* is used as measure of the degree of urbanization. The age groups are divided into three categories: the percentage of elderly population 65 years and older (*Pop>65)*, the percentage of population between 15 and 64 years (*Pop15_64)*, and the percentage of younger population up to 14 years of age (*Pop0_14*). A dichotomy variable is included (*Ddev)* to express the development level of each municipality. To assess the impact of the fiscal consolidation period 2011-2014, a dummy variable was constructed (*Dcrisis*), taking the value of one in each year over this period and zero otherwise.

Table 1 -Variable definition and data source

Variable	Definition	Unit	Data source
RECpc	Recycling level per capita	tons per capita	INE - Portuguese National Institute of Statistics (www.ine.pt)
MWGpc	Municipal waste generation per capita	tons per capita	
GVApc	Gross value-added (of non-financial enterprises) per capita	thousands of euros	
GVA1	Gross value-added in the primary sector as a percentage of total gross value-added	ratio %	
GVA2	Gross value-added in the secondary sector as a percentage of total gross value-added	ratio %	
GVA3	Gross value-added in the tertiary sector (services) as a percentage of total gross value-added	ratio %	
PopDen	Population density	average number of inhabitants per km^2	
Pop>65	The percentage of resident population over 65 years of age	ratio %	

Pop15_64	The percentage of resident population between 15 and 64 years old	ratio %	
Pop0_14	The percentage of resident population up to 14 years of age	Ratio %	
Ddev	Dummy variable with value 1 when the municipal *GVApc* is above the mean value and 0 otherwise	(0-1)	
Dcrisis	Dummy variable with value 1 for the years 2011-2014 and 0 elsewhere	(0-1)	
Melection	Assumes the value 1 in a municipal election year and 0 otherwise	(0-1)	National Electoral Commission (www.cne.pt)
Majority	Takes the value 1 when the local Town Council in office has a majority and 0 otherwise	(0-1)	
NoMajority	Takes the value 1 when the Town Council in office has no majority and 0 otherwise	(0-1)	
Left	Assumes the value 1 when the ruling party has a left-wing ideology and 0 otherwise	(0-1)	
Right	Assumes the value 1 when the ruling party has a right-wing ideology and 0 otherwise	(0-1)	
Independent	Takes the value 1 when the ruling local government is not linked to political parties and 0 otherwise	(0-1)	
Coalition	Takes the value of 1 when the ruling majority is a coalition of different parties and 0 otherwise	(0-1)	
Alignment	Assumes the value 1 when the Town Council and the majority of the Municipal Assembly belong to the same party and 0 otherwise	(0-1)	

Political characteristics are captured by binary variables which take the value of one when the characteristic occurs and zero when it is absent.

Before describing the political variables, we provide a brief description of how the local governments are organized in Portugal and how they are elected. There are two representative branches of local governance: the Town Council (the executive power) and the Municipal Assembly (the deliberative branch). The Municipal Assembly approves the general framework for local policies, which includes the approval of the municipal budget, the approval of local contracts and local taxes decided by the Town Council, and it monitors and supervises the activity of the Town Council. The Town Council is responsible for the implementation of all of these policies. In this framework the Mayor is the principal decision maker, who either assigns tasks to each Councillor or performs

other tasks himself, has some managerial autonomy regarding the Council (human resources, the signing of contracts, the issuing of licenses, etc.) and project prioritization, and their scheduling according to the activity plans.

The members of the Town Council are elected by voters in the municipality, and these are transformed by the d'Hondt[3] method into mandates. The Mayor is the first candidate of the list with more votes. The Municipal Assembly is elected directly by voters while the remaining members are the presidents of the parish councils -*Freguesias* - that belong to the municipality[4]. Since 2005, the municipal elections are held in September/October and the elected representatives take office until the end of November.

Concerning the political variables, *Melection* represents the year that municipal elections took place, *Majority* when the elected Town Council enjoys a single-party majority status, *NoMajority* when the Town Council governs with minority, *Coalition* when the majority is represented by a coalition of different political parties, *Left (Right)* indicates that the local executive in office is left (right) wing, *Independent* when the local government is not linked with political parties, and *Alignment* when the Town Council and the Municipal Assembly are of the same political ideology. The objective of introducing these political variables into the analysis is to verify whether the political composition of the elected local executive characterized by different political ideology, makes any difference in the recycling process across municipalities.

We need to clarify that the recycling policy adopted by the Portuguese municipalities is limited to the collection and delivery of the recycled waste to treatment centers. No other specific policies or monetary incentives are implemented to motivate households to participate more actively in the recycling process. Therefore, we are only able to assess the capacity to collect and deliver the recycled waste to the recycling centers. Given this, we test the hypotheses of whether the political ideology and composition of the ruling executives have an impact on the capacity to collect different volumes of recycled waste. On the other hand, the amount of recycled waste will depend on the environmental awareness and education of households, both influenced by the dissemination programs

[3] See Bormann and Golder (2013) for an overview of the electoral systems around the world.
[4] "Freguesias" are subdivisions of municipalities. The president of the Freguesia's council is elected directly by voters living in the area.

adopted by the local authorities. Unfortunately, there is no statistical information on the allocation of funds to recycling policies at the municipal level to test its effectiveness.

Descriptive statistics on the variables are reported in Table 2. The data set covers 305 Portuguese municipalities over the period 2009-2017, where data is available at this level of break down[5]. An unbalanced panel data set is used, since statistical information is not uniform for all variables over the total period considered. The sample is long enough to guarantee the asymptotic properties of coefficients in the estimation approach.

Table 2 shows that the mean value of yearly recycling is around 0.05 tons, varying between almost 0 and 0.65 tons per head. The very low values indicate that the recycling policy was not very effective in the respective municipality in a concrete year of the analysis. The mean value of municipal waste generated is 0.45 tons per head and the variation is higher than in recycling, between 0.028 and 1.52 tons per household. As in recycling, the values close to zero indicate that the corresponding municipality has not implemented a meaningful waste management policy. Gross value-added indicates a high heterogeneity of production among municipalities, which varies between 0.82 and 44 thousand euros per head with the mean value around 4.57.

Table 2 - Descriptive statistics of variables (overall values)

	Obs	Mean	Std. Dev.	Min.	Max.
RECpc	2704	.0556607	.0507784	.0001656	.6507881
wpc	2705	.4511083	.1474983	.0279189	1.52011
GVApc	2720	4.605326	4.001089	.821662	44.03478
GVA1	2690	.1235008	.144076	-.146249	.9511741
GVA2	2690	.3850527	.1870715	-.2890935	.9288232
GVA3	2692	.491484	.1686206	.0272699	1.018149
Pop0_14	2720	13.23147	2.612838	4.8	24.2
Pop15_64	2720	63.44702	4.360598	47.6	73.6
Pop>65	2720	23.3175	6.539472	7.8	45.5
Ddev	2720	.34375	.4750462	0	1
Popden	2720	299.6349	816.1909	4.1	7529.7
Left	2720	.5485294	.4977308	0	1
Right	2720	.4205882	.4937443	0	1

[5] Data collected according to availability of statistical information on recycling rate across the Portuguese municipalities started in 2009. We consider that a 9-year period might be enough to measure changes in behavior as it covers more than two electoral mandates and 3 local elections.

Independent	2720	.0308824	.1730307	0	1
Majority	2720	.7231618	.4475181	0	1
Coalition	2720	.1474265	.3545957	0	1
NoMajority	2720	.1294118	.3357168	0	1
Alignment	2720	.9227941	.2669669	0	1
Melection	2720	.3272059	.4692794	0	1
Dcrisis	2720	.4474265	.4973198	0	1

The shares of sectoral production show the dominance of the tertiary sector, corresponding, on average, to 49% of total production in contrast to the secondary sector with an importance of 38.5% and the primary sector accounting for 12.4% only. Differences in sector shares are very substantial among municipalities, reflecting differences in the production activity of the local economies[6]. Population density measures the degree of population concentration in local sub-units, with a mean value of around 299.7 residents per km^2, but the gap between the less populated municipalities and the more populated per km^2 is enormous. The age structure shows that the group of elderly population aged 65 and over, on average, for 23.3% of total population, but there are municipalities where almost half of the population (45.5%) is 65 and over. On the contrary, the share of younger population 14 years and younger corresponds, on average, to 13.2%, but there are municipalities where the younger generation represents only 4.8% of total population. The average share of population aged between 15 and 64 years corresponds to 63.4%, but there are municipalities where this age group amounts to 73.6% of the population. The dichotomy variable that splits the municipalities into value-added above and below the overall mean shows that the majority belongs to the latter case, characterized as less developed areas. The dummy variable capturing the austerity period 2011-2014 covers less than half of the total period considered in the empirical analysis (4 out of 9 years).

Regarding the political binary variables, it is shown that three municipal elections took place (in 2009, 2013 and 2017) during the total period considered; around 72.3% of the executive in office governed under a single party majority, 12.9% governed under a no majority regime, and 14.7% of municipalities were ruled with majority constituted by a coalition of different parties; around 42% of the local authority in office had a right-

[6] The negative minimum values reported in the primary and secondary sector are due to accounting definition of gross value-added, given by the difference between gross revenues and expenses of economic activities. These situations mostly occurred during the fiscal consolidation period, where economic activity declined significantly due to austerity measures.

wing ideology and 54.9% a left-wing ideology, while 3.1% were independent; 92.2% of the Town Council and the majority of the Municipal Assembly belonged to the same ideology.

4. MODEL SPECIFICATION AND ESTIMATION STRATEGY

The recycling equation using municipal panel data can be specified as follows:

$$RECpc_{it} = \sum_{k=1}^{p} \varphi_k RECpc_{it-k} + \alpha_1 GVApc_{it} + \alpha_2 GVApc_{it}^2 + \alpha_3 MWGpc_{it} + \theta' H_{it} + \\ + \delta' P_{it} + \pi T_t + v_i + \mu_{it} \quad (1)$$

where *RECpc* denotes the level of recycling per capita in the i^{th} municipality at year *t*, *MWGpc* is per capita municipal waste generation, *GVApc* stands for per capita gross value-added and serves as proxy for income indicator, *H* is a vector of other socio-economic control variables, *P* is a vector of political factors, v_i is the municipal fixed effect[7] and μ_{it} is the error term. A quadratic form is admitted with respect to the *GVApc* variable in order to test whether a non-linear relationship exists between the recycling level and production activity[8]. A threshold of production capacity is expected to be reached, after which the recycling rate increases and this is translated into a U-shaped behavior. This hypothesis will be validated when α_1 is negative and α_2 is positive, and both are statistically significant.

Waste generation variable (*MWGpc*) is expected to positively affect the recycling level, since more waste production will imply additional recycling efforts for protecting the environment. The set of other socio-economic control variables includes the share of sectoral production represented by the primary, the secondary and the tertiary sectors. The aim of introducing these variables is to assess whether the production structure of local economies affects the recycling process. Three age population groups are used to test differences in environmental behavior between a younger generation up to the age of 14 years, the 15 to 64 years age bracket, and the elderly population 65 years and over.

[7] This term captures differences between the Portuguese municipalities which are invariant in time, such as the size of the geographical area, location, natural resources, and institutions, among others.

[8] Income per capita should be used desirably as a wider economic indicator, but data on this variable is not available at the municipal level. However, we have to note that the total and sectoral production indicators we use are suitable proxies, since all productive sectors generate income to households and through consumption will determine the volume of waste production and the recycling activity.

Population density is also included as a direct determinant factor in recycling. A dummy variable representing the austerity years of budget consolidation from 2011 to 2014 is another covariate to test its impact on the recycling behavior. In this period, Portugal was under external intervention (the so-called TROIKA), which laid down severe restrictions on income that affected consumption and therefore the production of waste which determined the outcome of recycling[9].

Regarding the political factors, the expected effect of elections (*Melection*) is uncertain, depending on whether the executive engages in opportunistic behavior to maximize the probability of being reelected, and the population is sensitive to recycling concerns. As for the local government composition, whether the Town Council composition is a single-party majority (*NoMajority*), minority (*NoMajority*), or a party coalition majority (*Coalition*), the expected effect, is also, not clear. According to the portfolio allocation argument supported by Laver and Shepsle (1996), coalition executives will promote recycling policies, just as the executive member in charge of environmental issues will want to show its importance. On the other hand, Picazo-Tadeo et al. (2012) argue that decision-making is easier for a government enjoying a majority status, because the local authority does not need the support of other political parties to approve their measures.

Regarding the left-right spectrum (*Left*, *Right*, and *Independent* variables), according to most of the empirical literature which points out that left-wing governments are more sensitive to environmental issues, we expect to confirm this perspective in the case of recycling in the Portuguese municipalities.

The *Alignment* variable means that the Town Council and the Municipal Assembly are of the same ideology. This variable can be used to test the competing theories for institutional constraints: the veto theory versus the consensus approach.

Regarding the political variables we should note that they take the value one if the condition is met on the 1st of January of the corresponding year. As the elections take place in October and the new members of the local government take office in

[9] Given that the austerity measures during the fiscal consolidation period (2011-2014) affected globally the whole population (and not specific locations), we believe that the time dummy used in our model captures the effects of this specific period on recycling, through its effect on the standards of living of the whole population, influencing their recycling behavior.

October/November, the effect of a given year takes into consideration who is in power in most of that year and in the latest months of the previous year when the municipal budget is discussed. We included a *Trend*[10] in the estimated recycling equation to take into account the national effort to increase recycling in order to achieve the EU legal obligations regarding municipal waste management, written in the Waste Framework Directive (Directive 2008/98/EC).

Finally, we introduced in the recycling equation lags of the dependent variable. In doing so, we test whether recycling in the past is important for explaining current levels, and whether the learning process is fast or not. However, introducing the lagged dependent variable in a panel model creates an endogeneity problem. To overcome this problem, Arellano and Bond (1991) suggested the Generalized Method of Moments (*GMM*) approach, which consists in taking the first differences of variables and instrumenting the first differenced lagged values of the dependent variable by using previous lagged levels. The predetermined (lagged dependent variable) and other endogenous regressors[11] in first differences are instrumented by suitable lags of their own levels. Arelano and Bover (1995), and later Blundell and Bond (1998), suggested a modification of the original model, recommending the use of lagged levels and lagged differences. The *GMM* approach has one-step and two-step variants, the latter being asymptotically more efficient, since a finite-sample correction is made to the standard errors of coefficients, as indicated by Windmeijer (2005). The dynamic version of the recycling equation is estimated by using the *GMM* two-step difference system approach with robust standard errors. This approach is consistent with the partial adjustment mechanism.

5. EMPIRICAL EVIDENCE AND DISCUSSION

The model selection strategy obeys the following criteria. First, to disentangle the autocorrelation problem it was necessary to lag the dependent variable for two periods,

[10] As we used other time variables for the election years and the fiscal consolidation period (2011-2014) we opted not to use additional time-dummies in the regressions in order to avoid multicollinearity problems. To control for time effects and changes over time we included the trend variable.

[11] We assumed that most of the political variables used in the estimation approach are endogenous, as they result from individual behavior as people with higher environmental concerns will recycle more, but at the same time will vote in political parties that engage in local policies that promote recycling.

and this specification is consistent with the partial adjustment mechanism of order two[12]. Second, care is taken to ensure that the number of instruments not to exceed the number of units, a crucial condition when estimating dynamic models with panel data. Third, through the Hansen statistic the validity of instruments should always be confirmed. Four, a stepwise estimation approach is used, introducing new explanatory variables every time. This is a suitable process that checks for multicollinearity effects on the regression results and serves as a robustness checking test.

Following the referred strategy, six models are presented in Table 3 to check the importance of socio-economic factors for explaining the recycling performance of the Portuguese municipalities. The first thing to note is that the coefficients of the two-period lagged dependent variable are statistically significant at the highest 1% level in all models, confirming therefore the hypothesis that past values of recycling are important for determining current levels. The estimated dynamic models also allow us to measure the speed of adjustment[13] between the actual variation of the recycling level and its desired level. The calculated values show that the adjustment process is very quick, i.e. around 100% of the actual variation in recycling is adjusted to its desired level in a two-year period. Such high speed of adjustment should be associated with a very quick learning process of households, adopting policies that favor recycling activities.

We have tested for non-linearity in the relationship between recycling and waste, exhibiting an inverted U-shaped behavior, but this hypothesis is rejected as shown in Model (6). The coefficients of waste and its squared value, although with correct signs, display no statistical significance. All other models provide evidence that recycling per capita increases linearly with waste without achieving a turning point of saturation. It is shown that, on average, recycling increases by approximately 0.06 tons per head when waste per capita increases by one unit, while everything else is constant. This is an expected result since the volume of recycling depends potentially on the volume of the produced waste and the household awareness to adopt environmentally-friendlier policies.

[12] The partial adjustment mechanism of order two is defined as: $(RECpc_{i,t}-RECpc_{i,t-1}-RECpc_{i,t-2})= \delta(RECpc^*_{i,t}-RECpc_{i,t-1}-RECpc_{i,t-2})$ with $RECpc^*_{i,t}$ the unknown desired level of recycling and δ the adjustment coefficient. The left-hand side of this relation indicates the actual variation of the recycling level over two past periods and the right-hand side represents its desired variation (for more details see Greene, 2000, chapter 17, Pindyck and Rubinfeld (1991), Chapter 9).

[13] For example, using the results of Model (1) the speed of adjustment is given as: 1-0.361-(-0.375)=1.008

The U-shaped hypothesis between the recycling level and total production is also tested and this behavior is confirmed by all models, contrary to what was found by Valenzuela-Levi (2019a). As shown, the coefficient of *GVApc* is negative and the coefficient of its squared value is positive (significant at the highest 1% level), defining a turning point in gross value-added which varies between 25.96 and 27.47 thousand of euros[14] per head. Checking the data, we observe that only a few municipalities reached this threshold, up to when disassociation between the recycling level and economic activity occurs. This turning point is achieved basically by the Lisbon area and three other municipalities (Oeiras, Sines and Castro Verde). Therefore, more active policies should be developed by the remaining municipalities in order to attain higher levels of recycling, through a better management of solid waste and better dissemination of the benefits of recycling, as policy to protect the environment.

Table 3 - Results from the dynamic panel-data model with socio-economic variables. Two-step difference GMM on municipal recycling in Portugal, 2009-2017.

	Model (1) *RECpc*	Model (2) *RECpc*	Model (3) *RECpc*	Model (4) *RECpc*	Model (5) *RECpc*	Model (6) *RECpc*
RECpc-1	**0.361*** (12.25)**	**0.359*** (11.65)**	**0.359*** (11.65)**	**0.357*** (11.98)**	**0.357*** (11.98)**	**0.358*** (12.00)**
RECpc-2	**-0.375*** (-12.80)**	**-0.378*** (-13.10)**	**-0.377*** (-13.09)**	**-0.377*** (-12.85)**	**-0.377*** (-12.83)**	**-0.375*** (-12.67)**
Wpc	**0.0596** (2.23)**	**0.0595** (2.29)**	**0.0603** (2.32)**	**0.0564** (2.11)**	**0.0573** (2.13)**	0.0768 (1.26)
Wpc²						-0.0172 (-0.33)
GVApc	**-0.00986*** (-4.16)**	**-0.00993*** (-4.16)**	**-0.0100*** (-4.19)**	**-0.0106*** (-4.24)**	**-0.0108*** (-4.22)**	**-0.0106*** (-3.89)**
GVApc²	**0.000183*** (3.31)**	**0.000181*** (3.36)**	**0.000182*** (3.37)**	**0.000200*** (3.39)**	**0.000208*** (3.41)**	**0.000202*** (3.22)**
GVA2	**-0.0522*** (-2.97)**	**-0.0517*** (-2.96)**		**-0.0527*** (-3.00)**	**-0.0531*** (-3.00)**	**-0.0533*** (-2.98)**
GVA1			**0.0527*** (2.99)**			
GVA3	-0.0461 (-1.36)	-0.0532 (-1.57)	-0.00126 (-0.04)	-0.0449 (-1.36)	-0.0438 (-1.32)	-0.0435 (-1.31)
Pop0_14	-0.00285 (-1.11)	0.00338 (1.32)	-0.00230 (-0.82)	-0.00247 (-0.95)	-0.00224 (-0.85)	-0.00207 (-0.73)
Pop15_64	**-0.00544*** (-3.43)**		**-0.00575*** (-3.29)**	**-0.00528*** (-3.45)**	**-0.00537*** (-3.49)**	**-0.00539*** (-3.41)**
Pop>65		**0.00534*** (3.07)**				
Ddes				**0.0116* (1.84)**	**0.0117* (1.85)**	**0.0117* (1.83)**
PopDen					0.0000111 (0.54)	0.0000115 (0.56)
Dcrisis	**0.0204*** (4.61)**	**0.0202*** (4.62)**	**0.0201*** (4.60)**	**0.0210*** (4.70)**	**0.0210*** (4.71)**	**0.0209*** (4.70)**
Trend	**0.00663*** **	**0.00686*** **	**0.00677*** **	**0.00670*** **	**0.00679*** **	**0.00681*** **

[14] The turning point is calculated by taking the partial derivative of the recycling rate with respect to GVApc. Considering the values of Model (1) we get: $\partial RECpc_{it} / \partial GVApc_{it}$ = -0.00986 + +2*0.000183*$GVApc_{it}$ = 0, and solving for $GVApc_{it}$ we obtain the turning point $GVApc_{it}$ = 0.00986/2*0.000183=26.94.

	(4.41)	(4.38)	(4.31)	(4.49)	(4.41)	(4.40)
TP in *GVApc*	26.94	27.43	27.47	26.5	25.96	26.24
Obs.	1765	1765	1765	1765	1765	1765
Municip.	305	305	305	305	305	305
Instruments	301	301	301	301	301	301
AR(1)	-4.67 [0,000]	-4.65 [0,000]	-4.65 [0,000]	-4.69 [0,000]	-4.69 [0,000]	-4.69 [0,000]
AR(2)	1.14 [0.256]	1.18 [0.239]	1.18 [0.239]	1.14 [0.256]	1.14 [0.253]	1.15 [0.251]
Hansen	302.34 [0,297]	302.66 [0,293]	302.65 [0,293]	301.90 [0,289]	301.83 [0,249]	301.05 [0,273]

Notes: t statistics in parentheses (* p < 0.1, ** p < 0.05, *** p < 0.01); p-values in square brackets
Robust standard errors according to Windmeijer (2005) correction are used. The F-test assesses the joint significance of all slope coefficients, AR(1) and AR(2) are the Arellano-Bond tests for first and second order autocorrelation in first differences, the Hansen-test is used for testing over-identified restrictions (validating the instruments), and TP is turning point. The lagged dependent variable is instrumented by its own lagged values, the lagged values of all the other exogenous variables and the time trend variable.

One of the objectives of this study is to test whether the production structure of the local economies influences the recycling behavior. To our knowledge this hypothesis has not been tested in the literature, at least for municipalities. In the light of this proposition, we include as additional covariates in the recycling equation the shares of the primary (*GVA1*), secondary (*GVA2*) and tertiary (*GVA3*) sectors to check their relevance. We explicitly assume that all sectors enhance income to working population that will affect their consumption pattern, and therefore their waste and recycling behavior. To avoid multicollearity effects, one of the three variables should be omitted from the regression, and this is taken as the base for comparison. The same approach is employed concerning population age groups, since the proportions of the three groups also add up to 100%.

Following this strategy, the results of Model (1) of Table 3 are obtained by omitting the share of the primary sector and the share of the population group age 65 and over. It is shown that the secondary and tertiary sectors negatively influence the recycling performance in the Portuguese municipalities (relatively to the primary sector), but only the secondary sector displays statistical significance (at the 1% level). It is predicted that a one percentage point increase in the share of the secondary sector is associated with 0.0522 tons per capita decrease in recycling activity, when everything else is constant. Regarding the population age structure, evidence shows that the effect of the younger group with age up to 14 is not statistically significant, while the group of young people between 15 and 64 years affects negatively the recycling effort, displaying statistical significance at the 1% level. This indicates that a one percentage point increase of the group of the middle age population is responsible for 0.00544 tons per capita decline in recycling activity, other things remaining unchanged. Model (2) omits the second age

group and introduces the elderly population age 65 and over. It is shown that ageing population is positively associated with recycling activities, and is significant at the 1% level, while the impact of the younger population group is irrelevant. This is an interesting result that contradicts some findings in the literature that the elderly participate less in recycling activities due to physical barriers (Meneses and Palacio, 2005 and Terry, 2011), but corroborates other studies (such as Kinnaman and Fullerton, 2000 and Sideque et al., 2010) that corroborate the participation of the elderly actively in the recycling process, because they have more available time to spend in such activities and are more norm compliant.

Model (3) omits the share in production of the secondary sector and the elderly group. It shows that the primary sector contributes positively to the recycling process and this impact is statistically relevant at the 1% level. It is estimated that the increase of one percentage point of the production share in the primary sector is responsible for 0.0527 tons per capita increase in recycling, while everything else remains constant. This can be because people working in this sector are in closer contact with nature and understand better the need to preserve the environment.

Evidence from Models (5) to (6) highlight the negative impact of the secondary sector and the second population group (between 15 and 64 years) on recycling performance across the Portuguese municipalities. The overall conclusion through all the alternative estimated models points out the positive impact of the primary sector and the group of elderly population on recycling activities in comparison to other sectors and other age groups, respectively.

As it is shown through all models, the impact of the fiscal consolidation period on recycling is clearly positive and statistically significant at the 1% level in all cases. This reveals an interesting result that despite the reduction in income and contraction in economic activity due to austerity programs imposed by international creditors, the recycling activity increased approximately 0.02 tons per head, on average, over the period 2011-2014. This can be taken as evidence that the recycling process is not only driven by income related factors, but also by issues associated with the household's perception of how important it is to adopt green practices to preserve the environment.

Another important factor in the recycling equation is *Trend* showing a growing trend in recycling activity over the period considered, and this is observed through all models. Moreover, population density does not make any important contribution, as Models (5)

and (6) highlight. This result is in line with what was found by Sidique et al. (2010) and Valenzuela-Levi (2019b), but contrary to the findings of Romano et al. (2019). The development dichotomy variable (*Ddev*) shows a positive association with recycling activity, but its significance is verified at the 10% level only. Therefore, we have some indication that more developed municipalities are more recycling-oriented, but this conclusion is not very robust. Moreover, the positive effect is in line with the majority of studies explained in the literature review, Section 2.

Table 4 presents new estimations (Models 7 to 13) by adding in the recycling equation the political factors jointly with the socio-economic variables. The first thing to notice is that there is no significant change for both, the sign and the magnitude of almost all the effects concerning the socio-economic variables. The only difference is that the variable representing the level of development *Ddev* is no longer significant, concluding that this result is not robust when political factors are included in the model.

Table 4 - Results from the dynamic panel-data model with socio-economic and political variables. Two-step difference GMM in municipal recycling in Portugal, 2009-2017.

	Model (7) *RECpc*	Model (8) *RECpc*	Model (9) *RECpc*	Model (10) *RECpc*	Model (11) *RECpc*	Model (12) *RECpc*	Model (13) *RECpc*
RECpc-1	**0.348*** (10.28)**	**0.349*** (10.29)**	**0.348*** (10.28)**	**0.348*** (10.29)**	**0.348*** (10.28)**	**0.347*** (10.25)**	**0.348*** (10.28)**
RECpc-2	**-0.386*** (-13.31)**	**-0.387*** (-13.30)**	**-0.386*** (-13.31)**	**-0.386*** (-13.28)**	**-0.386*** (-13.31)**	**-0.386*** (-13.11)**	**-0.386*** (-13.30)**
Wpc	**0.0450* (1.79)**	**0.0445* (1.76)**	**0.0450* (1.79)**	**0.0459* (1.80)**	**0.0450* (1.79)**	**0.0464* (1.81)**	**0.0448* (1.78)**
GVApc	**-0.00896*** (-3.17)**	**-0.00890*** (-3.17)**	**-0.00896*** (-3.17)**	**-0.00903*** (-3.18)**	**-0.00896*** (-3.17)**	**-0.0104*** (-3.55)**	**-0.00892*** (-3.23)**
GVApc²	**0.000165** (2.35)**	**0.000165** (2.36)**	**0.000165** (2.35)**	**0.000166** (2.35)**	**0.000165** (2.35)**	**0.000195*** (2.73)**	**0.000164** (2.43)**
GVA2	**-0.0564*** (-2.94)**	**-0.0553*** (-2.89)**		**-0.0561*** (-2.88)**	**-0.0564*** (-2.94)**	**-0.0563*** (-2.94)**	**-0.0562*** (-2.94)**
GVA1			**0.0564*** (2.94)**				
GVA3	-0.0373 (-1.04)	-0.0367 (-1.03)	0.0190 (0.50)	-0.0375 (-1.02)	-0.0373 (-1.04)	-0.0327 (-0.90)	-0.0373 (-1.04)
Pop0-14	-0.00269 (-0.90)	0.00345 (1.13)	-0.00269 (-0.90)	-0.00277 (-0.91)	-0.00269 (-0.90)	-0.00254 (-0.84)	-0.00272 (-0.88)
Pop15-64	**-0.00618*** (-3.61)**		**-0.00618*** (-3.61)**	**-0.00620*** (-3.65)**	**-0.00618*** (-3.61)**	**-0.00625*** (-3.57)**	**-0.00618*** (-3.59)**
Pop>65		**0.00586*** (3.37)**					
Ddes						0.00814 (1.23)	
PopDen							-0.00000184 (-0.09)
Left	0.0000492 (0.01)	0.000423 (0.05)	0.0000492 (0.01)		0.0000492 (0.01)	-0.000610 (-0.06)	0.000121 (0.01)
Right				-0.000278 (-0.03)			
Independent	0.00000555 (0.00)	0.000376 (0.02)	0.00000555 (0.00)	-0.000131 (-0.01)	0.00000555 (0.00)	-0.00148 (-0.08)	0.00000473 (0.00)
Majority	0.00751 (0.86)	0.00733 (0.83)	0.00751 (0.86)	0.00746 (0.87)	-0.0104 (-0.75)	0.00808 (0.91)	0.00755 (0.86)

Coalition	0.0179 (1.29)	0.0181 (1.30)	0.0179 (1.29)	0.0181 (1.31)		0.0182 (1.33)	0.0179 (1.30)
NoMajority					-0.0179 (-1.29)		
Alignment	**-0.0202* (-1.73)**	**-0.0198* (-1.71)**	**-0.0202* (-1.73)**	**-0.0207* (-1.75)**	**-0.0202* (-1.73)**	**-0.0221* (-1.89)**	**-0.0203* (-1.76)**
Melection	**-0.00385* (-1.84)**	**-0.00380* (-1.81)**	**-0.00385* (-1.84)**	**-0.00378* (-1.82)**	**-0.00385* (-1.84)**	**-0.00365* (-1.75)**	**-0.00384* (-1.84)**
Dcrisis	**0.0229*** **(4.38)**	**0.0228*** **(4.37)**	**0.0229*** **(4.38)**	**0.0226*** **(4.34)**	**0.0229*** **(4.38)**	**0.0229*** **(4.36)**	**0.0229*** **(4.40)**
Trend	**0.00745*** **(3.92)**	**0.00751*** **(3.93)**	**0.00745*** **(3.92)**	**0.00738*** **(3.86)**	**0.00745*** **(3.92)**	**0.00756*** **(3.92)**	**0.00743*** **(3.84)**
TP in GVApc	27.15	26.97	27.15	27.20	27.15	26.67	27.20
Obs.	1765	1765	1765	1765	1765	1765	1765
Municip.	305	305	305	305	305	305	305
Instruments	298	298	298	298	298	298	298
AR(1)	-4.81 [0.000]	-4.81 [0.000]	-4.81 [0.000]	-4.81 [0.000]	-4.81 [0.000]	-4.83 [0.000]	-4.81 [0.000]
AR(2)	1.27 [0.204]	1.27 [0.204]	1.27 [0.204]	1.27 [0.203]	1.27 [0.204]	1.26 [0.208]	1.27 [0.205]
Hansen	300.59 [0,202]	300.30 [0,203]	300.59 [0,202]	298.87 [0,222]	300.59 [0,202]	299.91 [0,198]	300.52 [0,191]

Notes: The same as in Table 3.

Regarding the impact of the political variables, the first thing to note is that political ideology of the Town Council in office (whether right or left-wing or independent) does not significantly impact the levels of recycling per head[15]. All estimated coefficients are close to zero and statistically not significant. Our results do not support the partisan hypothesis that left-wing Town Councils are more prone to recycling policies, which is contrary to what we expected, given that previous studies[16] found a positive association between environment protection and left-wing ideology. We should clarify that in the Portuguese municipalities there is not a significant representation of political parties with "green ideology" able to introduce active policies to protect the environment.

As for the political composition of the Town Council (whether enjoying a majority or minority or constituted by a coalition of different parties), the results in table 5 show that it is equally unimportant for explaining differences in recycling[17]. Attempts to consider different combinations between the political orientation of the executive and its composition status failed to provide significant results. Therefore, neither the theory of the portfolio allocation model supported by Laver and Shepsle (1996), nor the idea that

[15] In all models except in model 10 we used the right-wing as base case versus the left or the independent, while in model 10 we used the left-wing as the base case, for the sake of robustness.
[16] See for instance Nuemayer (2003), Garmann (2014), Knill et al. (2010) or Wen et al. (2016).
[17] In all models except in model 11 we used *NoMajority* as the base case, while in model 11 we used *Coalition* as the base case, for the sake of robustness.

enjoying a majority status gives the power to implement environmental protection policies are confirmed by our results.

It is shown that when the Town Council and the Municipal Assembly share the same political ideology (Alignment) this is relevant for recycling and it is statistically significant at the 10% level[18]. On average, when the Council and the Assembly are of the same political ideology recycling is reduced by 0.02 tones per head. This result, although not surprising as it is supported by the institutional constraints consensus theory of Lijphart (1999), is contrary to what was found by Knill et al. (2010).

Finally, table 4 shows that election years are statistically relevant at the 10% level only. With respect to the political cycle, the evidence suggests that in years of municipal elections recycling is reduced by approximately 0.004 tones per head (around 5% of mean recycling per capita), on average, assuming everything else is constant. This variable is used to test the opportunistic behavior of the Town Council. An opportunistic executive in election years can use popular policies to maximize its chance of being reelected. As the recycling activity implies considerable effort (to sort waste at home and delivery waste at the drop-off points) on behalf of citizens, it seems that the executives avoid promoting such policies in their political campaign, believing that by relaxing hard rules and making every-day life easier will increase chances of reelection.

6. CONCLUDING REMARKS

To test the importance of socio-economic and political factors for the recycling performance, a dynamic model is estimated using panel data on 305 Portuguese municipalities over the period 2009-2017. It is shown that a two-period lagged dependent variable model is appropriate to obtain efficient estimates and this is consistent with the partial adjustment model of order two. The evidence suggests that the adjustment process of current recycling behavior to its desirable level is very fast and can be achieved completely in two years. This result indicates a fast-learning process in recycling activities and should be associated with the educational level and household awareness regarding environmental concerns. Our evidence also supports the non-linear relationship between recycling and gross value-added per head, which is consistent with the U-shaped

[18] We should note that in most municipalities the Town Council and the Municipal Assembly are ideologically aligned, contributing to the low level of significance of the effect found.

hypothesis. Above a certain threshold, recycling increases with production through the income effect. However, few municipalities cross the turning point, therefore municipalities should put more effort into developing policies that favor better management of recycling waste through effective collection and dissemination of the benefits of processing the waste produced.

The empirical analysis also shows that the production structure of the local economy is an influential factor for recycling activities. Our evidence indicates that the secondary sector (through the income effect) is negatively associated with recycling activities, in contrast to the primary sector that positively affects the household recycling effort. Meanwhile, the tertiary sector plays an insignificant role in the recycling process. This result supports the previous finding that few municipalities reached the threshold after which recycling increases with production.

The age structure of the population is also relevant for explaining differences in recycling behavior. The evidence is surprising and reveals that the elderly participate more actively in the recycling process in contrast to the second age bracket, whose efforts are negative. As expected, the contribution of the first age bracket is not significant in this process. Policies should be oriented towards the active population group (second age bracket) promoting the benefits of recycling in order to preserve the environment. Environmental education and dissemination programs are essential for achieving this goal.

Other socio-economic factors, such as population density and the development dichotomy variables are not important for explaining the recycling pattern. It is shown that recycling performance between the more developed and less developed municipalities is not significantly different, and that population concentration does not put any strain on developing more active recycling policies. Another finding is that during the fiscal consolidation period 2011-2014 recycling increased, which suggests that it is also linked with cultural aspects and household awareness to protect the environment.

The second group of factors that explain the recycling process includes variables that characterize the political ideology and structure of the Town Council. Among the political variables only two are found to be important for shaping the recycling path, with weak statistical significance. First, it is shown that the political cycle influences recycling to some extent, i.e. during the years of municipal elections recycling decreased. This result

is consistent with the political opportunism hypothesis, revealing that during electoral years environmental issues are not dominant in the political agenda and this should be explained by the absence of independent parties with green ideology that could bring some dynamics to the environmental debate. Therefore, the introduction of environmental topics in the political agenda during municipal elections should be a policy recommendation to reverse the negative recycling outcomes and raise voter awareness of environmental practices. Second, evidence shows that there is less recycling when the Town Council and the Municipal Assembly in office share the same political ideology. This result indicates that when there is a full political power in the local government, environmental issues (like recycling) are neglected due to weak political opposition. To change this negative trend, voters should change their political preference in favor of a more diversified cabinet composition providing stronger competition that could introduce environmental issues into the political debate.

All other political factors tested in this study have no bearing on the recycling behavior. In particular, no differences are found in recycling policies irrespective of the political ideology of the Town Council in office (left-wing, right-wing or independent). This result is not in conformity with the partisan hypothesis that left-wing executives are more sensitive to environmental quality and act more effectively to achieve this goal. A similar result is found when the political status of the executive in office is considered. Whether the executive governs with a majority or minority or is a coalition of different parties does not make any difference in the recycling process. This is not an encouraging result from the political point of view as it reveals lack of awareness of the Town Council and low political diversification of environmental issues. This political scenario should be changed for the sake of preserving the environment, implying a more effective management policy for recycling most waste produced.

APPENDIX

Pairwise Correlation matrix of variables

Variables	*RECpc*	*Wpc*	*GVApc*	*GVA1*	*GVA2*	*GVA3*	*PopDen*	*Pop>65*	*Pop15_64*	*Pop0_14*
RECpc	1.000									
Wpc	0.353	1.000								
GVApc	0.094	0.135	1.000							
GVA1	0.020	0.025	-0.037	1.000						
GVA2	-0.182	-0.334	0.143	-0.507	1.000					
GVA3	0.185	0.349	-0.127	-0.292	**-0.676**	1.000				
PopDen	0.076	0.105	0.463	-0.180	-0.056	0.216	1.000			
Pop>65	0.043	-0.151	-0.167	0.276	-0.127	-0.096	-0.221	1.000		
Pop15_64	-0.073	0.089	0.153	-0.289	0.169	0.059	0.198	**-0.964**	1.000	
Pop0_14	0.015	0.229	0.162	-0.210	0.034	0.142	0.223	**-0.895**	**0.744**	1.000
Melection	0.019	0.031	0.028	-0.014	0.018	-0.008	0.001	0.013	-0.016	-0.006
Left	0.063	0.090	-0.010	0.167	-0.108	-0.023	-0.023	0.010	-0.032	0.028
Right	-0.074	-0.092	-0.043	-0.157	0.122	-0.001	-0.032	-0.002	0.021	-0.031
Independent	0.029	0.003	0.156	-0.032	-0.040	0.072	0.164	-0.025	0.034	0.007
Majority	-0.083	-0.118	-0.123	-0.038	0.056	-0.029	-0.149	0.092	-0.074	-0.107
NoMajority	0.115	0.098	0.064	-0.016	-0.071	0.093	0.106	-0.026	0.024	0.025
Coalition	-0.004	0.056	0.095	0.064	-0.003	-0.051	0.088	-0.091	0.071	0.111
Alignment	-0.059	-0.056	0.009	-0.010	0.064	-0.063	-0.055	-0.007	-0.011	0.035

Variables	*Melection*	*Left*	*Right*	*Independent*	*Majority*	*NoMajority*	*Coalition*	*Alignment*
Melection	1.000							
Left	-0.034	1.000						
Right	0.035	**-0.943**	1.000					
Independent	-0.003	-0.189	-0.150	1.000				
Majority	0.010	-0.075	0.094	-0.054	1.000			
NoMajority	-0.020	0.092	-0.143	0.148	**-0.622**	1.000		
Coalition	0.006	0.008	0.016	-0.072	**-0.675**	-0.157	1.000	
Alignment	0.009	0.121	-0.139	0.051	-0.013	0.057	-0.037	1.000

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