TITLE: Policies and variables affecting recycling rates in the Vallès Oriental

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ABSTRACT:

As the planet gets closer to exhaust its resources, the change from the linear economy –where products are simply disposed of after being used–, to a circular one –a closed cycle where everything is recycled and reused– becomes crucial.

Since 1994 European Union (EU) laws have pushed European governments to tighten their recycling policies in order to achieve the target of 65% of waste being recycled by 2035. Each government, and hence, each municipality, have designed and applied different strategies to reach this goal.

This paper analyses how municipal level policies together with socio-demographic variables affect the recycling rate of 39 municipalities in the Vallès Oriental county, located in Catalonia, Spain, between 2000 and 2018.

The results strongly suggest that the door to door waste collection method is the most effective. Further, European directives also have a major influence on recycling rates. Each directive sets a deadline where a new improved recycling percentage needs to be achieved. Coinciding with these different deadlines, a drastic increase of recycling is observed across the board in all municipalities.

Finally, the results obtained here also highlight that unemployment affect negatively recycling rates.

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1. INTRODUCTION

According to a United Nations report, anthropogenic carbon dioxide emissions “need to be drastically cut in order to avoid the destructive effects of climate change in our planet. For this purpose it is proposed that by the year 2030 the emissions should be decreased by half those emitted in 2010” (IPCC, 2018, pg. 12). To achieve this, it is imperative to rapidly change how our modern societies use the natural resources in order to be able to avoid an irreversible environmental damage. Such risk is due extensive reliance to the linear economy; a system where products are disposed of after being used. A global shift to a circular economy is fundamental to halt environmental degradation and the exhaustion of natural resources.

The circular economy is a system that mimics the way nature works: a closed cycle where everything is reused. The goal of circular economy is to reuse non-degradable materials; elevating the efficiency of resource usage to lengthen the availability of natural resources. Therefore, fighting the overexploitation of resources and addressing scarcity. Circular economy is not just trying to reduce the overexploitation of resources but also to promote the efficient use of them and avoid dumping our waste creating an ecologic problem. It is about producing new products using old ones and therefore closing the cycle (Ellen Macarthur Fundation, n.d.). Circular economy embraces the 3 Rs: Reduce, Reuse, and Recycle.

Many governments are developing policies in order to promote the shift towards circular economies. In particular, the European Union has been working on this transition for years now with two main approaches (European Commission, 2020).

1. The producers’ approach Ą Making laws to ensure sustainable products. Focus on the sectors that use most resources and where the potential for circularity is high such as: electronics and information and communication technology (ICT); batteries and vehicles; packaging; plastics; textiles; construction and buildings; food; water and nutrients
2. Consumers approach Ą Encouraging consumers through campaigns but also through the promotion of national policies to ensure less waste and to make the circular attainable for people, regions and cities.

In this work, the focus will be set on the consumer approach and particularly on the variables affecting recycling and waste collection. The area analysed is the Vallès Oriental, a county of 0.4 million inhabitants[1], in the Spanish Autonomous Community of Catalonia.

In the Vallès Oriental there is a startling variation in the recycling rates achieved by different municipalities, ranging from 24% to 87%. This work aims to shed some light on the reasons behind these different results and identify the main factors that affect either positively or negatively municipal recycling rates. To do so, in this paper I will first compile a database starting from institutional databases and collecting new data through an ad-hoc survey. I will then apply an econometric model to empirically evaluate the successfulness of different models on recycling. The variables where the focus will be set on are the collecting method used by each municipality, the policies implemented to boost recycling, population and other demographic variables such as income per capita, age groups or immigration.

The next sections of this paper are organized as follows:

Section 2 sets the legal background and regional context of the analysis.

Section 3 presents the data used and the statistical methods.

Section 4 includes results.

Section 5 includes a discussion.

Section 6 summarizes the main conclusions.

Additional material is presented as Annexes. Annex I, contains the questions handed to the persons responsible for the environment issues of each municipality. Annex II, displays the dataset used. And Annex III, presents a string code table for the number associated with each municipality.

[1] Based on 2018 data.

2. BACKGROUND

2.1 Legal framework

The European Union introduced its first directives on waste management in the early 1980ies. Since then several directives have been adopted, the most crucial being:

The 1994 Packaging Directive (94/62/EC) was the first to harmonize a common answer to waste management. This directive obliged countries to introduce systems to return and/or collect used packaging; set recycling rate goals and how to achieve them; promoted recycling and education campaigns to the general public and instated harmonized data collection methods to be able to track and compare all the countries in the EU (European Commission, 1994).

The 2004-05 Packaging Directive (2004/12/EC) transformed the 1994 directive into a law to be implemented before the end of 2005. The directive included two overall goals: i) that 60% of waste should be recovered or incinerated by 2008; and ii) that 55-80% of all packaging waste should be recycled by 2008 (European Commission, 2004).

The 2008 Packaging Directive (2008/98/EC) established key waste management principles by introducing a waste management hierarchy of actions: prevention, preparing for re-use, recycle, recovery and disposal. It also introduced the "polluter pays principle" and a new target to recycle 50% of household waste by 2020 (European Commission, 2008).

The 2018 Packaging Directive (2018/851/EC) revised the previous legislative by setting stricter recycling rates targets for municipal waste: 55% by 2025; 60% by 2030 and 65% by 2035. In addition, it requires a reduction in municipal landfill waste to less than a 10% of the total. As well, it introduced stricter laws to make producers pay for the collection of recyclable items and to reduce food waste (European Commission, 2018).

Since 1993, the Catalan Government has been setting more ambitious goals. On 1993 the Catalan Parliament approved a law (**Law 6/1993)** instating the mandatory collection of

organic waste and of waste separation for recycling (Parlament de Catalunya, 1993). In 2018, a new law (**Law 210/2018)** introduced stricter goals compared to the 2018 European Directive. It required 60% of all municipal waste to be recycled by 2020 and also aimed at a 50% reduction in domestic and commercial food waste (Ministeri d'Agricultura i Pesca Alimentació i Medi Ambient, 2018).

2.2 Regional context

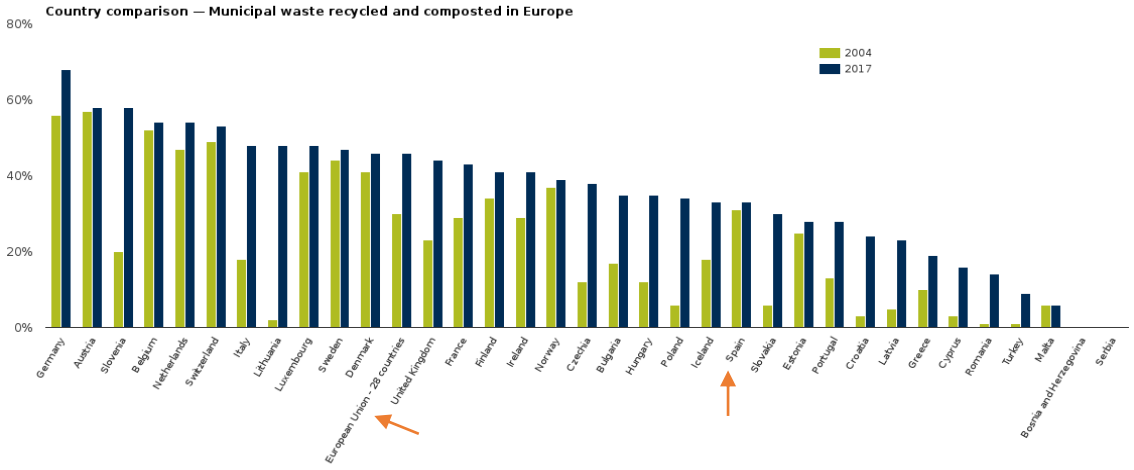
Are these goals being met?

Some European countries have some of the highest recycling rates in the world, together with some Asian countries like Singapore, South Korea, or Taiwan all above the 55% recycling rate (European Environamental Bureau (EEB), 2017). In the European Union, only 3 countries manage to be above the 55% rate established in the latest EU directive: Germany (68%), Austria (58%) and Slovenia (58%) (European Environment Agency, 2019).

Despite this, the European Union average recycling rate was 46% in 2017, an increase of 16 percentage points from 2004. In 2017, Spain ranked 22nd out of 28 with a recycling rate of 33%, with an increase of just 2 percentage points in 13 years. In 2004 Spain ranked 10th in the European Union with a recycling rate above the European average, but it fell behind at 13 points below the average in 2017.

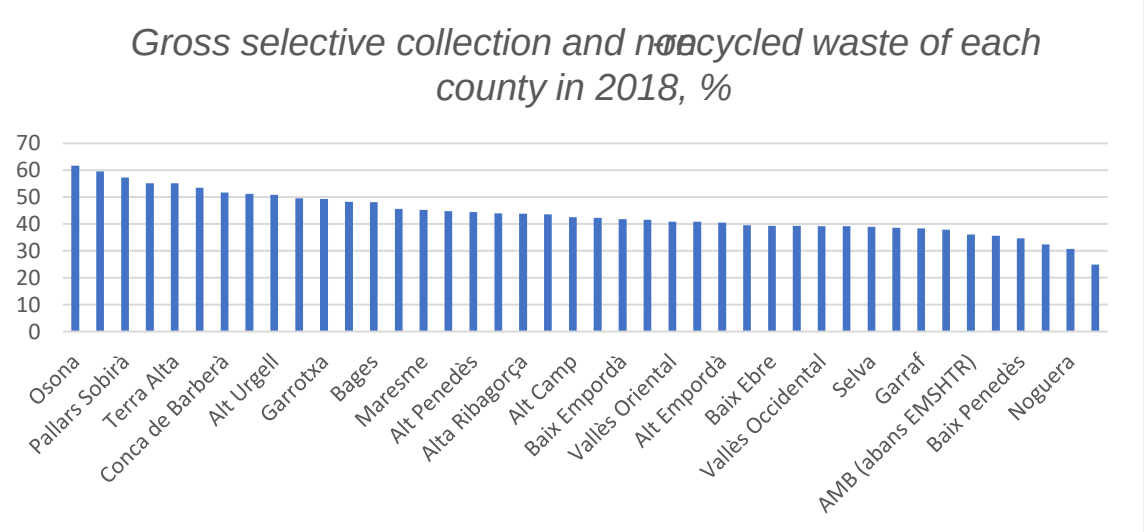
In Catalonia, the recycling rate has sensibly increased from 14% in 2000 to 40.5% in 2010. After then however, the growth in the recycling rate has substantially slowed down, reaching 41.7% in 2018, well below the EU average and target goal, as shown in Figure 1 below (Agència de Residus de Catalunya, n.d.).

Figure 1. Country comparison-Municipal waste recycled and composted in Europe. Source: European Environment Agency, 2019



Within Catalonia, there is a substantial variation in recycling rates from the 25% of Cerdanya to 62% in Osona in 2018. Vallès Oriental *comarca* (county) is in the middle of the table when we compare it with the other counties of Catalunya. In 2018 it ranked 25th out of 42 counties with a recycling rate of 40.9% (Figure 2).

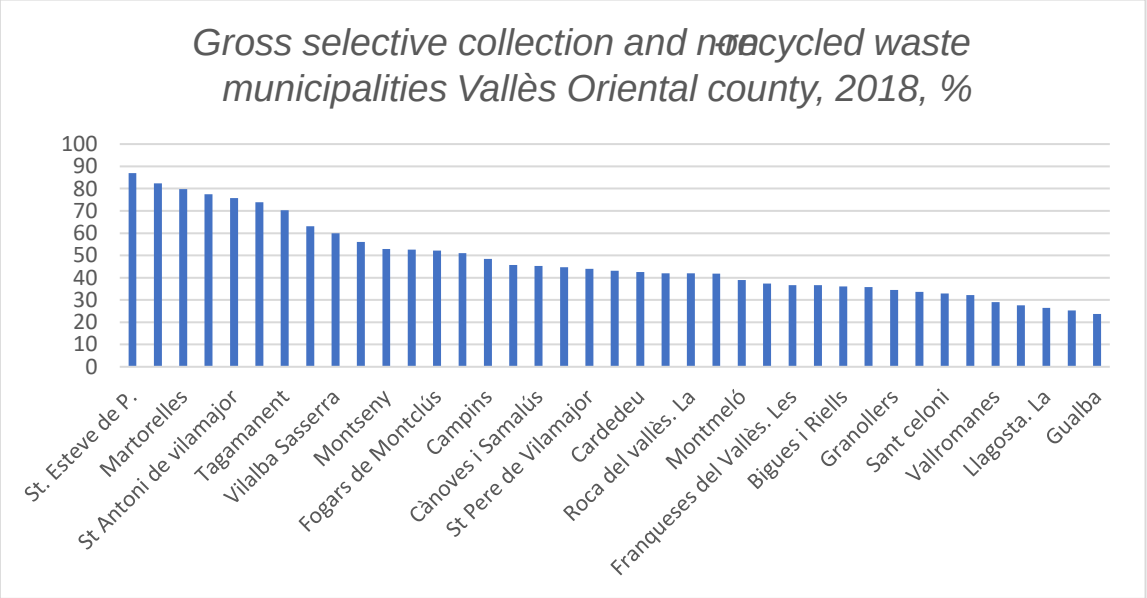
Figure 2. Gross selective collection and non-recycled waste of each county in 2018 in percentages.



Note: Although all counties are represented in the bar lines, not all the names appear.
Source: Agència de Residus de Catalunya n.d.

Large differences in recycling rates can also be observed when we focus on the Vallès Oriental, where some municipalities are struggling to reach 25% rate like Canovelles (25,3%) or Gualba (23,6%) while others such as Sant Esteve de Palautordera recycle an astonishing 86.9% or Aiguafreda with an 824% (Figure 3).

Figure 3. Gross selective collection and non-recycled waste of each municipality of Vallès Oriental county in 2018 in percentages



Note: Although al counties are represented in the bar lines, not all the names appear.
Source: Agència de Residus de Catalunya n.d.

How can such differences in recycling rates can arise within such a small geographic domain? When comparing different countries, we can often expect cultural or infrastructural differences to explain differences in outcomes. However, the same justification is hard to apply for differences within the same region, even more within the same county.

Why is there a difference of more than 50 percentage points between two municipalities that are just 6.4 km away from each other? The following report will try to give a rational answer to this striking phenomenon.

2.3 Literature Review

Several studies that have tried to explain how socio-demographic variables could affect the recycling rate ((Ibáñez-Forés et al., 2018) (Calabrò & Komilis, 2019) (Drimili et al., 2020) (Tsalis et al., 2018)). These studies highlight how different variables such as age, education, income, persons per household or religion affect recycling.

It has been shown that education is one of the important variables for increasing the recycling awareness. However, this does not always translate into an increase of recycling rates. For instance, in the region of Joao Pessora, Brazil (Ibáñez-Forés et al., 2018), looks like higher education together with recycling instructions are found to be an important variable affecting the willingness to recycle. Similar results are also found in Xanthi (Tsalis et al., 2018) and Athens (Drimili et al., 2020), both in Greece but with less significance. In sharp contrast, in Reggio Calabria, Italy (Calabrò & Komilis, 2019), no significant differences were found on this aspect. Therefore, it would have been of interest to evaluate in this work the correlation between education and recycling rate in Vallès Oriental. Unfortunately, I was not able to obtain reliable data on this issue.

Another variable under study is how age could affect the recycling rate. This variable seems controversial. While in Brazil (Ibáñez-Forés et al., 2018) and Xanthi (Tsalis et al., 2018) appears to be significant, in Athens (Drimili et al., 2020) and Reggio (Calabrò & Komilis, 2019) is not. This could be due to how this variable is measured, since different age ranges are used it is very difficult to compare among the four studies.

Another variable is income but in any of the studies ((Tsalis et al., 2018), (Drimili et al., 2020)) where it is considered, this variable turns out to be non-significant for affecting the recycling rate.

Even if unemployment has been considered as a variable on the Athens' study (Drimili et al., 2020), any result or discussion is omitted.

Differences in the used methodology are found across the different papers. A problem that arises when comparing these studies is the difference in the methodology used. While the Brazilian (Ibáñez-Forés et al., 2018) and the Italian (Calabrò & Komilis, 2019) studies are based on public information, both Greeks studies (Tsalis et al., 2018)(Drimili et al., 2020) are based on surveys, with a sample size of around 500 people in the Athens one and 150 in the Xanthi one.

Closer to this case study, a report carried out by Agència de Residus de Catalunya (ARC), the Catalan waste agency (SPORA, 2018), took into account seasons, population size, economic activity and waste collection method among others. Although the report is not backed by an econometric analysis, it focuses on different cases, being especially interesting the case of Vilablareix, where the report describes the advantages of the door to door waste collection method over the traditional method.

Zheng et al (2017) include a theoretical work on the benefits and drawbacks of door to door method and how a better response of door to door can be achieved. This work concludes that, although being more expensive, door to door is perfectly economically achievable and must be accompanied by developing awareness and creating a legal framework to ensure its accomplishment (Zheng et al., 2017).

The aim of this paper is to analyse how both kind of variables, collection methods and socio-demographic variables affect the recycling rate.

3. DATA AND METHODS

3.1 Data description

The area of Valles Oriental, focus of this study, comprises 39 municipalities. The data collected includes municipal level waste and recycling and covers 19 years, from 2000 to 2018.

The database is constituted by data gathered from institutional sources and from an ad-hoc survey that the author sent to the person in charge of environmental issues in each of the 39 municipalities. More specifically:

- **Quantities of garbage collected** by type and disposal mode for each municipality and year was downloaded from ARC (Agència de Residus de Catalunya, n.d.)
- **Qualitative information regarding the waste collection method**, the type of entity managing the collection, and whether educational programs or economic incentives were in place were collected through an ad-hoc survey and phone interviews (see Annex I).
- **Demographic data** were downloaded from IDESCAT, the Catalan Statistics Institute (Institut d'Estadística de Catalunya, n.d.). They include population, age

distribution, place of birth, most voted party, sex distribution and number of inhabitants per house.

- **Economic data** were downloaded from IDESCAT, the Catalan Statistics Institute (Institut d'Estadística de Catalunya, n.d.) and the HERMES programme from "La Diputació de Barcelona"(Diputació de Barcelona, n.d.). They include the gross disposable family income per capita (RBFD/capita), number of affiliates to the social security in the general and autonomous regime by sectors, total unemployment, average estate tax paid in the municipality (IBI) and average income declared in the municipality (IRPF).

A total 84 variables were collected and pre-screened (Annex II). After filtering and creating new variables form the ones collected, 52 variables were assumed to affect recycling rate and after a first round of analysis, the author identified 43 variables as the most relevant ones. They are described in the table 1 below.

Table 1. Variables description and sources

Variable	Description	Source
	Waste variables	
ŭ ˙Y ˙O ő ώ ő ü ˙O ˙O	*Is a 0-100 index measuring the amount of garba recycled per municipality, considering only the sur organic waste, plastic, paper, glass, and non-recycled waste as total garbage at time t.*	*ARC*
ŭ ˙Y ˙O ő ώ ü ˙O ˙O	*Lag values of the previous period of the varia P_RECYCLED at time t.*	*ARC*
¨Y ŭ ¨Y ö ü ώ ö ¨Y¨Y ˙O ö ö ŭ ¨O¨Y	*Is a continuous variable measuring the total amoun waste generated per capita at time t.*	*ARC*
	Sociodemographic variables	
ŭ ŭ ü	*Is a continuous variable measuring the number inhabitants per municipality at time t*	*IDESCAT*
ŭ ŭ ü ˙O ˙O ŭ ¨Y	*Is a continuous variable presenting the result of divi population by surface of municipality. The units given in people per squared kilometre at time t.*	*IDESCAT*
˙Y ő ¨O˙O ő ö ŭ ¨O¨Y ö	*Is a continuous variable presenting the disposable g family income per capita per municipality at time t.*	*HERMES programme*

ü ű ˙Y ˙O ü ˙Q ű	*Is a 0-1 dummy variable capturing whether they a more men than women in the municipality. Set to there is more male people in the municipality an otherwise at time t.*	*IDESCAT*
¨O ö ő ¨O ü ˜Y ¨Y ˙O	*Is a continuous variable measuring the number inhabitants per house, being the result of dividing I by IBI receipts at time t.*	*IDESCAT*
ő ˛Y ű ˙O ü ő ü ű ˙O ˙O	*Is a 0-100 index measuring the number of population an unemployment situation. Computed as pec unemployed divided by total municipality population time t (data only available from 2005 to 2018).*	*IDESCAT*
	Garbage collection variables	
˙O-O ˛ő ˜Y ˙Y ˙Q	*Is a 0-1 dummy variable capturing whether th municipality is collecting the municipal garbage only door to door scheme. Set to 1 if the municipality collecting the garbage with only a door to door scheme and 0 otherwise at time t.*	*ad-hoc survey*
˙O-O ˛ώ ¨Y ¨Q O ü ö ¨ ˛ő ¨Y ő ü ώ ˛O	*Is a 0-1 dummy variable capturing whether th municipality is collecting the organic waste, pap plastic and non-recycled waste in a door to door schem and glass in a conventional scheme. Set to 1 if municipality is collecting the garbage in the abo mentioned scheme and 0 otherwise at time t.*	*ad-hoc survey*
ő ű ü ώ ˛ő Q Y ¨Q ű ˙Y ¨O ü ö ˛¨Q Q ő ˛ő	*Is a 0-1 dummy variable capturing whether th municipality is collecting the paper, plastic, glass a non-recycled waste in conventional scheme and org waste in a door to door scheme. Set to 1 if municipality is collecting the garbage in the abo mentioned scheme and 0 otherwise at time t.*	*ad-hoc survey*
˙O-O ˛ü ü ü ˛ő ˙Y ő ˙Q ˜Y	*Is a 0-1 dummy variable capturing whether th municipality is collecting the municipal garbage in a d to door scheme but only in the suburbs, keeping the conventional system in the urban core. Set to 1 if mu nicipality is collecting the garbage in the abo mentioned scheme and 0 otherwise at time t.*	*ad-hoc survey*
˙O-O ˛O ώ ˛ű ˜Y ˙Y ˙Q	*Is a 0-1 dummy variable capturing whether th municipality is collecting the municipal garbage in form of door to door scheme excluding D2D_PURE. to 1 if the municipality is collecting the garbage in abovementioned scheme and 0 otherwise at time t.*	*ad-hoc survey*
˙O-O ˛ö ü ώ ú ¨O ű ˙O	*Is a 0-1 dummy variable capturing whether th municipality is collecting the municipal garbage in form of door to door scheme. Set to 1 if the municipa is collecting the garbage in the abovementioned scheme and 0 otherwise at time t.*	*ad-hoc survey*

ü ˜Y ŭ ¨O ŏ ¨O Ů ö ü ¨O¨Y ö	*Is a 0-1 dummy variable capturing which collecti entity is responsible of the collection method, in this the municipality itself. Set to 1 if the municipality responsible of collecting the garbage in the municip and 0 otherwise at time t.*	*ad-hoc survey*
Ů ´Y¨O ȯ ö Y´O	*Is a 0-1 dummy variable capturing which collecti entity is responsible of the collection method, in this a private firm. Set to 1 if a private firm is responsibl collecting the garbage in the municipality and otherwise at time t.*	*ad-hoc survey*
ü ¨O ö ¨Y ŏ ȯ ŭ Ů Y ¨O ü ˜Y ŭ	*Is a 0-1 dummy variable capturing which collecti entity is responsible of the collection method, in this a mixt of responsible of consortium of the Vallès orie (CVO) and the municipality or the consortium of th Vallès Oriental and a private firm. Set to 1 if the ab organizations are responsible of collecting the garb in the municipality and 0 otherwise at time t.*	*ad-hoc survey*
ŏ ȯ ŭ	*Is a 0-1 dummy variable capturing which collecting entity is responsible of the collection method, in this the consortium of the Vallès Oriental. Set to 1 if the is responsible of collecting the garbage in municipality and 0 otherwise at time t.*	*ad-hoc survey*
	Age groups	
Ů ȯ ŭ π ω	*Is a 0-100 index measuring the percentage population between 0 and 9 years old. Computed population between 0 and 9 years old divided by t municipality population at time t.*	*IDESCAT*
Ů ȯ ŭ ρ π ς τ	*Is a 0-100 index measuring the percentage population between 10 and 24 years old. Compute population between 10 and 24 years old divided by t municipality population at time t.*	*IDESCAT*
Ů ȯ ŭ ς υ φ μ	*Is a 0-100 index measuring the percentage population between 25 and 64 years old. Compute population between 25 and 64 years old divided by t municipality population at time t.*	*IDESCAT*
Ů ȯ ŭ φ υ ω τ	*Is a 0-100 index measuring the percentage population between 65 and 94 years old. Compute population between 65 and 94 years old divided by t municipality population at time t.*	*IDESCAT*
	Place of origin	
Ů ȯ ŭ ˜Y¨Y ŭ	*Is a 0-100 index measuring the percentage of population born outside Vallès Oriental. Computed population born outside Vallès Oriental divided by t municipality population at time t.*	*IDESCAT*

	Time dummies
dt_2 - dt_19	*are 0ς1 dummy variables capturing the effect of beinς the year 2001*dt_2 is*set to 1 if the year is 2001 and otherwise.* dt_3 is*set to 1 if the year is 2002 and 0 otherwise. E*

3.1.1 Data specifications

In this work, attention has been restricted on the recycling rates for plastic, glass, organic waste, paper and non-recycled waste. Other recyclable materials -such as self-composting, pruning and gardening, bulky waste + wood, electrical and electronic equipment (WEEE) waste, scrap metal, vegetable oils, textile, runes, special waste- were excluded from the present work for two reasons. First, these additional types of waste are not produced nor collected on a daily basis, and, second data for these types are only available from 2012 whereas data for other categories are available since year 2000.

Even if there are 4 different collecting methods provided by ARC: surface dumpster, under surface dumpster, door to door and pneumatic dumpster, this work has only considered the collecting methods that municipalities stated on the questionnaire. These are: a) Conventional, b) surface dumpsters, c) door to door method, d) mixed method door to door for organic waste and conventional for all the other waste and e) mixed method door to door for every waste except of glass, collected with conventional dumpsters.

The original intention was to collect monthly data on the garbage disposed from each municipality, to investigate any seasonal effect on recycling. However, this was abandoned, after realizing that most municipalities do not collect these data on a monthly basis. Thus, annual data on garbage disposal was decided to use for all municipalities extracted from the ARC database, therefore ensuring consistency in the data collection methodology.

3.2 Methods

The data has been organized in a panel data format composed of 39 cross-sectional units (municipalities) observed over 19 time periods (years) with 54 variables and 741 observations.

To analyse the data, the open-source statistical econometrics program Gretl was used.

The econometric analysis was undertaken in different steps.

The first step consisted on running OLS regressions using the percentage of recycled waste as dependent variable and, then test independently each of the independent variables alone to identify those with a statistically significant coefficient.

The second step involved checking the correlation coefficient amongst variables to identify possible risks of multicollinearity. It was considered to be highly correlated when the correlation coefficient between variables was higher than 0.7. Once the highly correlated variables were detected, the variable of the pair that seemed to fit better in the model was kept i.e. houses/surface was dropped in and population density kept.

Among other variables that were dropped: whether a recycling program had been accompanied by an environmental education campaign, and whether some form of economic incentives had been attached to different recycling schemes. The coefficients for these variables were not statistically significant, presumably, owing to the lack of accuracy in the information collected in the ad-hoc surveys (not all respondent knew whether such campaigns/incentives were in place and had incomplete information on this regard). Another promising variable that was dropped was the most voted party in the municipality in each municipal election since 1999 (every 4 years). Probably, political parties turned out to be statistically non-significant because the most voted party is not always the ruling party, and thus, it is hard to influence the policies affecting recycling.

Third, to refine the model, some of the selected variables were transformed using Gretl into squares, logarithms, interactions and lags.

Then, different models were creates choosing different variables to obtain the final results using pooled ordinary least squares.

Each of the models obtained were tested for heteroskedasticity using the White test. In case that heteroskedasticity was found, robust standard errors were used.

To know which kind of regression was better to use with the collected data, different tests were conducted.

- To detect a structural brake in the data, a Chow test was applied.

- To diagnose if the pooled OLS model was adequate, in favour of the fixed effects alternative, a Joint significance of differing group means test was used.
- To diagnose if the pooled OLS model was adequate, in favour of the random effects alternative, a Breusch-Pagan test was applied.
- To check if the random effects model is consistent in favour of the fixed effects model, a Hausman test was completed.

Finally, once selected the analysis that fitted better the whole data, the model was conducted, and to discard autocorrelation problems, the Durbin-Watson criteria was checked.

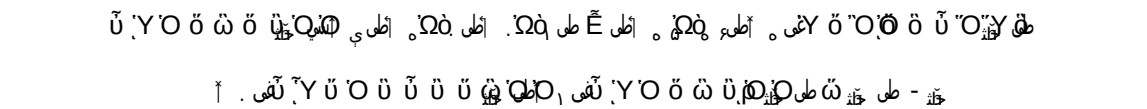
To end the filtering of data, the following variables were also dropped leaving the final data set with 43 variables. These variables are IRPF and the variables related to it, IBI and the variables that are related to or that depend from it and altitude.

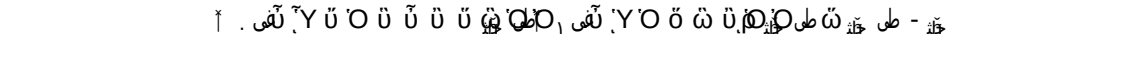
Once the data was filtered, some of the resulting variables were transformed to logs, squares, interactions and lags using Gretel's platform to better fit the data and reduce the effects of few outliners. To better represent population data, habitants per house and RFBD/ capita, a square transformation was applied. As information on the previous year's recycling rate seemed as an important part of the model, thus a Lag was performed on it. To end up, to be able to identify if the effect of some independent variables on the recycling rate are different for different values of other independent variables, a interact through multiplying them is applied. The independent variables transformed are population and the dummy variable of door to door and RFBD/capita and the dummy variable door to door.

The last step before creating the final model was adding, also using Gretl, 19-time dummy variables representing each of the 19 years under study.

4. RESULTS

Regression were estimated in the form:





Where:

- MODEL1,  is composed of:

- MODEL1.1,  is composed of:

- MODEL1.2,  is composed of:

- MODEL1.3,  is composed of:

- MODEL1.4, is composed of:

- MODEL1.5, is composed of:

The results can be found in table 2.

Table 2. Models testing garbage collection method and collecting entity variables

VARIABLES	MODEL1	MODEL1.1	MODEL1.2	MODEL1.3	MODEL1.4	MODEL1.5
const	32.4531***	28.2334**	28.7094**	20.8301*	22.5456**	22.4959**
	(12.0299)	(11.5955)	(11.6045)	(10.5805)	(10.5723)	(10.1762)
RBFD_CAPITA	−0.0941237	−0.0953849	−0.136794	−0.0372246	−0.162554	−0.160083
	(0.537342)	(0.540371)	(0.51542)	(0.543263)	(0.537702)	(0.519406)

P_UNEMPLOYED	−1.61964***	−1.51473***	−1.53380***	−1.59390***	−1.58873***	−1.58719***
	(0.545954)	(0.533517)	(0.53628)	(0.548169)	(0.539306)	(0.537687)
D2D_PURE	20.4194***	19.405***	-	20.3046***	19.7269***	-
	(3.18487)	(3.70368)		(3.2661)	(3.22175)	
D2D_WTH_GLASS_CONVE	41.4144***	-	-	28.1604***	-	-
	(5.20465)			(2.55691)		
CONVE_WTH_ORGNAIC_D2D	26.2715***	-	-	26.3069***	-	-
	(3.10771)			(3.11101)		
D2D_ONLY_URBES	4.88586***	-	-	5.04076***	-	-
	(0.943292)			(0.903757)		
D2D_EXC_PURE	-	21.9574**	-	-	19.5989***	-
		(8.40085)			(6.5911)	
D2D_ANY_KIND	-	-	20.0714***	-	-	19.6889***
			(3.67577)			(3.40102)
MUNICIPALITY	−13.2620***	−6.74584***	−6.12735	-	-	-
	(4.0425)	(6.26746)	(6.2596)			
PRIVATE	−8.52313	−3.75160***	−3.12516	-	-	-
	(8.38824)	(7.6687)	(7.56309)			
MIXTCVOPRIVMUN	−9.77879	−4.43031***	−3.84567	-	-	-
	(8.30279)	(7.63837)	(7.49973)			
CVO	-	-	-	12.7181***	12.52***	12.5185***
				(4.65325)	(4.54878)	(4.53384)
P_RECYCLED_1	0.391926***	0.423746***	0.424197***	0.3941***	0.413862***	0.413867***
	(0.0563043)	(0.0586691)	(0.0583148)	(0.0569609)	(0.0568421)	(0.0568408)
dt_2	−17.9498***	−16.8584***	−17.0683***	−17.3585***	−17.3025***	−17.2887***
	(3.36378)	(3.35314)	(3.34681)	(3.48135)	(3.44505)	(3.42398)
dt_3	−20.0295***	−19.0385***	−19.3119***	−19.3597***	−19.5526***	−19.5351***
	(4.76673)	(4.86445)	(4.81781)	(4.86118)	(4.91993)	(4.83837)
dt_4	−15.0145***	−14.0009	−14.2901***	−14.3208***	−14.5485***	−14.5300***
	(4.5561)	(4.51162)	(4.44428)	(4.63294)	(4.60769)	(4.47596)
dt_5	−19.3486***	−18.5041*	−18.7758***	−18.6922***	−18.9653***	−18.9481***
	(4.28924)	(4.35824)	(4.28695)	(4.37694)	(4.4069)	(4.33006)

dt_6	−10.6587***	−9.93865***	−10.0888***	−10.1149***	−10.0870***	−10.0777***
	(3.23456)	(3.28078)	(3.13372)	(3.31537)	(3.26237)	(3.1999)
dt_7	−0.507694	0.302703	0.169648	0.0183827	0.0621316	0.0712046
	(4.66438)	(4.56549)	(4.50851)	(4.82352)	(4.77879)	(4.71952)
dt_8	−5.07219**	−4.62212	−4.74768*	−4.61137*	−4.70223*	−4.69403*
	(2.45762)	(2.49449)	(2.41037)	(2.60089)	(2.58427)	(2.50604)
dt_9	−4.33488**	−4.12960	−4.28681**	−3.90913*	−3.99704*	−3.98844*
	(2.11959)	(2.07894)	(1.99763)	(2.19881)	(2.15164)	(2.10055)
dt_10	2.06424	2.37358	2.2254	2.5022	2.47822	2.48492
	(2.67138)	(2.54241)	(2.50618)	(2.75336)	(2.6048)	(2.60774)
dt_11	3.4443	3.57401*	3.45264	3.83452	3.78634	3.79111
	(2.35087)	(2.31205)	(2.24657)	(2.4025)	(2.31537)	(2.29962)
dt_12	2.8244	2.85916	2.7411	3.20439	3.11074	3.11514
	(2.59139)	(2.55319)	(2.46286)	(2.65446)	(2.55174)	(2.52756)
dt_13	3.70921	3.6829	3.58275	4.06559	3.98927	3.99234
	(2.52873)	(2.4609)	(2.3905)	(2.55955)	(2.44557)	(2.43293)
dt_14	5.00147*	4.94984	4.86698*	5.35548*	5.2652*	5.26726*
	(2.95771)	(2.89255)	(2.8313)	(3.00216)	(2.89403)	(2.88448)
dt_15	2.2332	1.74752	1.71537	2.42623	2.0039	2.00387
	(2.13235)	(2.15834)	(2.09799)	(2.19617)	(2.17887)	(2.17843)
dt_16	1.53103	1.19189	1.16366	1.72214	1.39817	1.39834
	(1.62897)	(1.63196)	(1.57558)	(1.72078)	(1.68596)	(1.68339)
dt_17	0.0355805	−0.211718	−0.226429	0.186511	0.00883772	0.00842187
	(1.3764)	(1.34764)	(1.3208)	(1.47084)	(1.45604)	(1.46082)
dt_18	0.124039	−0.0580199	−0.0546154	0.249331	0.165144	0.163905
	(1.01605)	(1.02486)	(1.01394)	(1.1253)	(1.13357)	(1.13802)
Number of observations	702	702	702	702	702	702
Within r2	0.657178	0.645064	0.6448	0.656604	0.649836	0.649835
Log-likelihood	−2553.997	−2566.186	−2566.448	−2554.585	−2561.435	−2561.436

Note: This table reports coefficient estimates and standard errors from six separate least squares regressions. The dependent variables vary across regression as indicated in the column headings. All regressions include fixed effects and robust standard errors *** p<0.01, ** p<0.051, * p<0.1

According to the result of MODEL1, all the collecting method dummies appear to be significant at 10, 5 and 1%. However, when this data is analysed in depth, only one town uses D2D_WTH_GLASS_CONVE. The same happens with CONVE_WTH_ORGNAIC_D2D and D2D_ONLY_URBES. As they are the only town using that collection method, it is difficult to check if the result is because of the kindness of the collecting method or because other unobserved effects. In fact, door to door but only in suburbs (D2D_ONLY_URBES) incurs an even worse problem. The lack of data about population of the suburbs or about the amount collected in the precise suburb becomes a major issue for the reliability of this variable.

A similar problem is found with the collection entity. While there are a lot of municipalities that use CVO, only some use alternatives, a fact that can seriously bias the results.

In table 2, all the intercepts of the models appear to be significant, although as we merge the different variables, we start to lose significance. It is also very interesting to see how the coefficient diminishes about 10 points in all models where CVO is being used with respect to the ones where it is not used. This gives us the indication that CVO is capturing these 10 percentage points. Analysing in depth the meaning of this value, it is vital to remember that we have different dummies, so, when they are equal to zero it means that the collection method being used is the conventional one and the collecting entity is CVO. So, when all the variables are equal to 0, the recycling rate using conventional method and being carried out by the CVO corresponds to the coefficient of the variable constant.

Regarding to RBFD_CAPITA, surprisingly, appears to be non-significant in all models. One possibility for this result to turn out non-significant could be that the income variance in Vallès Oriental is not large enough to reflect differences in recycling patterns.

As expected, unemployment is significant at 95% in all models, stating that an increase of 1% in unemployment reduces the recycling rate between 1.5 and 1.6% depending on the model. The unemployment has long been related with education (Maine Dept. of Labor, 2003), and that could be a plausible explanation of this result. Recycling is thought to be linked to education and as a result, it could be assumed that the municipalities that suffer from larger unemployment rate recycle less.

There is an interesting factor that relates the impact of the recycling rate of the previous year on the recycling rate of the current year. This is nicely reflected in the

P_RECYCLED_1 coefficient, which is significant at 99% in all six models with a positive coefficient between 0.39 and 0.42. This result is very important since it shows that independently of the other variables, the expected recycling rate will be increased in the range of 0.39% and 0.42% of the actual recycling rate.

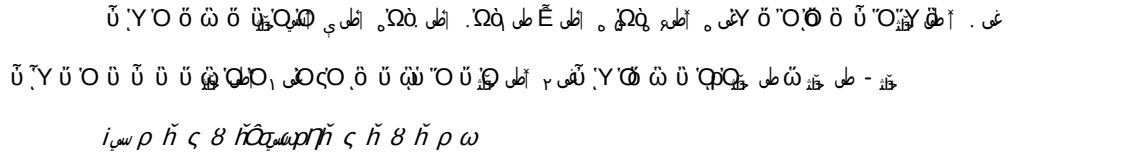
Another interesting, but somewhat, expected result are the year dummies. The first 5 years, from 2001 to 2006, are all significant at 99% (expect for MODEL1.1). The interesting information comes along with the regressor dt_6 (significant at 99%) and two more regressors (dt_8 and dt_9) significant at between 90% and 95%, respectively (expect for MODEL1.1). The change of the penalization from year 2004 to year 2005 is of between positive 8.5 and 9 percentage points, meaning that, keeping all the other variables constant, in average, municipalities will recycle about 8.5% more in 2005 compared to 2004. Similar results are observed when year 2005 is compared to year 2007 and 2008. In this case, the penalization for moving from year 2005 to year 2008 is around a positive 6%. One could think these results are because people are becoming more aware of recycling, but even if some part of this assumption was true, it is certainly not one of the major parameters of influence. The reason is found in the introduction of this paper. It is not by chance that the year 2005 is the deadline year for the implementation of the 1994 Packaging Directive (94/62/EC). The same happens with the increase observed along the years 2007 and 2008 since the latter was the deadline for the implementation of the 2004-2005 Packaging Directive stating that 60% of waste must be recovered or incinerated by no later than 2008 and that between 55 and 80% of all packaging waste must be recycled by 2008.

Given these results, the data suggests that the most reliable variable representing the collection method is D2D_ANY_KIND. This variable manages to dilute the effect of the collection methods that are only carried out in one municipality. This advocates for grouping the variables results in a more realistic model avoiding the above-mentioned particular cases suspected to be creating disturbances. As a result, in the next models, only D2D_ANY_KIND will be considered.

As it can be observed in MODEL1.3 and MODEL1.5, D2D_ANY_KIND is significant at 99% with a coefficient of about 20%. This is a crucial result since it shows the importance of the door to door collection method with respect to the traditional one.

The values obtained from model 1.3, model 1.4 and model 1.5 suggest that variable CVO affects positively at our dependent variable. Due to reasons explained in the discussion section, variables related to collection entity will be dropped.

To find out the effect of different variables related to population, four more models are proposed with the following base formula:



Where:

- MODEL2.1, is composed of:

- MODEL2.2, is composed of:

- MODEL2.3, is composed of:

- MODEL2.3, is composed of:

Table 3. Models testing population related variables

VARIABLES	MODEL2.1	MODEL2.2	MODEL2.3	MODEL2.4
const	37.4998*** (10.1672)	34.8249*** (12.7589)	27.9454** (11.735)	19.399 (18.9846)
RBFD_CAPITA	−0.152371 (0.471235)	−0.0714815 (0.505767)	−0.297169 (0.731473)	−0.0430027 (0.532667)
P_UNEMPLOYED	−1.17154* (0.580571)	−1.05106* (0.571561)	−1.56900** (0.61847)	−1.39993** (0.529391)
D2D_ANY_KIND	18.4775*** (4.25189)	18.4301*** (4.21925)	19.1019*** (4.24162)	19.2103*** (4.31429)

POP	−0.00114100* (0.000625938)	-	-	-
POP_DENS	-	−0.0128109 (0.00878009)	-	-
P_YO09	-	-	−0.0873123 (0.394078)	-
P_YO1024	-	-	−0.191168 (0.5419)	-
P_YO2565	-	-	0.206948 (0.25484)	-
P_YO6594	-	-	−0.357134 (0.40224)	-
P_OUT_VO	-	-	-	0.0804234 (0.303933)
P_RECYCLED_1	0.42011*** (0.0531155)	0.424431*** (0.0560971)	0.424658*** (0.0613562)	0.428975*** (0.0622373)
dt_2	−19.3748*** (3.86445)	−17.7704*** (3.33215)	−18.9617*** (6.05434)	−16.1219*** (3.44998)
dt_3	−20.5759*** (4.64836)	−18.9868*** (4.90904)	−21.3227*** (6.59398)	−18.2863*** (4.99213)
dt_4	−15.0105*** (4.59324)	−13.4398*** (4.48804)	−16.5210*** (5.72296)	−13.2732*** (4.54748)
dt_5	−19.2432*** (4.23426)	−17.8058*** (4.34283)	−21.1726*** (6.57674)	−17.8724*** (4.57728)
dt_6	−11.3730*** (3.22034)	−10.4057*** (3.39426)	−12.5091** (5.34274)	−9.65203** (3.67326)
dt_7	−0.593825 (4.26462)	0.271402 (4.63232)	−2.08267 (5.62417)	0.711558 (4.64233)
dt_8	−5.22508** (2.47842)	−4.52487* (2.52448)	−6.86434 (4.31105)	−4.30737 (3.0072)
dt_9	−4.93019** (2.00303)	−4.42056** (2.13461)	−6.51056* (3.56911)	−4.10616* (2.36009)

dt_10	0.852072 (2.41212)	1.1498 (2.59108)	−0.137392 (3.70011)	2.10467 (2.75192)
dt_11	1.99445 (2.22983)	2.14645 (2.35061)	1.32311 (2.92539)	3.23243 (2.40761)
dt_12	1.28514 (2.46072)	1.35877 (2.46099)	0.780037 (2.97383)	2.49841 (2.56483)
dt_13	1.96835 (2.33158)	1.92665 (2.44529)	1.83313 (2.62556)	3.27978 (2.40928)
dt_14	3.18992 (2.78475)	3.1161 (2.84919)	3.29074 (3.03524)	4.55156 (2.78973)
dt_15	0.284787 (2.06188)	0.255845 (2.11798)	0.410653 (2.34275)	1.40836 (2.13039)
dt_16	0.102907 (1.52496)	0.127432 (1.5698)	0.168031 (1.95599)	0.96967 (1.59863)
dt_17	−0.948711 (1.30055)	−0.946710 (1.28432)	−0.857765 (1.38891)	−0.380213 (1.33809)
dt_18	−0.469094 (1.01201)	−0.451503 (1.02251)	−0.418045 (1.06233)	−0.181563 (0.998511)
number of observations	702	702	702	702
within r2	0.644753	0.644572	0.643049	0.642165
Log-likelihood	−2566.494	−2566.672	−2568.173	−2569.042

Note: This table reports coefficient estimates and standard errors from four separate least squares regressions. The dependent variables vary across regression as indicated in the column headings. All regressions include fixed effects and robust standard errors. *** p<0.01, ** p<0.051, * p<0.1

The results obtained above (table 3) shows that the constant variable calculated is very different along the four models. While the models using population and population density are significant at 99%, the model using age groups is significant at 95%, moreover it has a much lower coefficient compared to the previous ones (of about 10%). Furthermore, the constant of MODEL2.4 turns out to be non-significant.

In all four models, RBFD_CAPITA is non-significant while P_RECYCLED_1 and D2D_ANY_KIND are significant at 99% in all models. The year dummies have similar coefficients and significance levels as in the previous model, that is, years 2001-2005 and

2007-2008 are significant, with exception of MODEL2.3 and MODEL2.4 where the year 2007 is non-significant. Unemployment turned out to be significant in all models but with only 90% in MODEL2.1 and MODEL2.2 and 95% in MODEL2.3 and MODEL2.4.

Looking at the different models it can be seen that, the only variable related to population that appears to be significant is population itself with a coefficient of −0.00114 and with only a 10% of confidence. This means that for an increase of 1000 people, the recycling rate will drop by 1.14%.

With the results presented in table 3, the model that represents better the recycling situation in Vallès Oriental with the current data is MODEL2.1 because it is the only model where population related variable is significant and the recommendations of only using D2D_ANY_KIND are met.

In this model, the constant coefficient is 37.5 and has a 99% significance. RBFD_CAPITA is not significant at 1, 5 or 10%. Unemployment affects negatively with a coefficient of -1.17 being only significant at 10%. As in all the other models, D2D_ANY_KIND is a crucial explanatory factor with a positive coefficient of 18.48 being significant at 1%. As well as D2D_ANY_KIND, P_RECYCLED_1 is also significant at 1% with a coefficient of 0.42. Finally, 5-year dummy variables are significant at 1% being them dt_2, dt_3, dt_4, dt_5 and dt_6, and 2 year dummy variables are significant at 5% being them dt_8 and dt_9. In this model, population is also significant at 90%. This means that the more population the less is recycled.

To summarize, we can consider that the MODEL2.1 is the one that manages to put forward all the important variables collected. Therefore, this model should be a powerful tool to pursue the increase of recycling rates in the future.

5. DISCUSSION

The effects and plausible causes of the relevant variables have already been discussed in each model proposed. In this section the discussion will be focused on a global level.

Without any doubt, it can be stated that, any form of door to door method leads to a substantial increase in the percentage of waste recycled with a nearly 20% increase. Even if it is a more costly method, any municipality willing to increase the recycling rate and

helping to stop the global warming should not hesitate to implement it. This has also been demonstrated in the study presented by the ARC (SPORA, 2018) where in the two cases that changed from a conventional to a door to door scheme resulted in an astonishing increment of recycled waste (from 39 to 88% in Vilablareix and from 13 to 71% in the municipalities associated to La Plana commonwealth). In the same way, the municipalities in this study with the highest recycling rate in 2018 are collecting the waste door by door (Sant Esteve de Palautordera 84% and Aiguafreda 75.5%).

Stricter European laws have also proved to increase the recycling rate. A clear evidence of this is the increase of recycling observed after the implementation of the 2004 and 2008 European directives that may suggest that they have been effective in achieving their goals. Even if European environmental policies are becoming more and more strict, there is still room until the 100% recycling rate is achieved. Some authors have already related the importance of implementing policies to increase the percentage of recycled waste (Calabrò & Komilis, 2019) (Drimili et al., 2020).

The results show that the collecting entity responsible of the waste collection is also important. In this analysis four types of responsible are considered: municipality, private, public consortium and a mixt of public-private partnerships. The data suggests that CVO is the most efficient. The fact that CVO manages a vast number of municipalities of Vallès Oriental, opens the possibility of having achieved scale economy, and thus, become more efficient when collecting the waste. Nevertheless, to correctly asses the effect of the collecting responsible additional information is needed, for example, who decides the frequency of the collection, in case of traditional collection how many dumpers are allocated per person or surface, etc. At the end of the day, the collector's work is just to gather the waste created, consequently, if the frequency of collections and other policies depend only form the town hall, who collects the waste should not matter.

Another variable that appears to be important in all models is unemployment. Even if the coefficient is not a very large number, when multiplied against unemployment the result can end up being a large number. To the best of our acknowledge, no study has been published related to the effect of unemployment and the recycling rate. This value is thought to be related with education, but the lack of proper information on education, makes it difficult to extract a solid conclusion. Another possibility is that unemployment could also cause people to get distracted from environmental actions such as recycling and become more focused on issues which are more urgent to them. Analysing it deeper

there could be another reason related more to the municipality than to its citizens. As a result of unemployment, a decrease in tax revenues or an increase in social security expenditure at the municipal level could decrease the amount of budget available to recycle properly. Maybe, in order to decrease this coefficient, it could be interesting to add a bonus on the unemployment benefit for recycling. Nowadays, many municipalities use some kind of discount on waste tax for going to the green point. It could be interesting to make an even greater discount to this group of the population to see if it helps boosting the percentage of recycled waste.

With the data obtained, age group appears to be non-significant (MODEL2.3) that is in agreement with other authors that have not found a significant relationship between age groups and the recycling rate ((Drimili et al., 2020) (Calabrò & Komilis, 2019). As stated in the literature review, this is a controversial variable since some other authors have found just the opposite ((Ibáñez-Forés et al., 2018) (Tsalis et al., 2018)).

The results of the last model also point out the current negative effect of population on recycling rates. This could be explained because in large cities with high density areas and areas with high buildings (Knickmeyer, 2020), recycling can be harder to manage. In this kind of cities door to door could seem impossible to implement. But it is proven that is totally possible to implement it, and to become a leading recycling city such as Taipei. Where a door to door system is used and the rate of recycling is up to 67% of their waste even if they have a population of over two and a half million inhabitants and a density of nearly 10.000 inhabitants per square kilometre (Chen, 2016)

Regarding environmental education, one of the questions proposed in the survey sent to the environmental responsible was which kind of environmental educational events were carried out in the municipality. Unfortunately, the answers were vague and thus, impossible to extract valuable information to be used as a variable. This is one of the most important issues that several authors have pointed out to be crucial when trying to improve the recycling rate. Targeted communication and educational programmes seem to be very important (Knickmeyer, 2020) (Van Der Werff & James, 2008). Showing the importance of recycling and how they are contributing to improve their present and their future in order to ensure public acceptance and participation (Drimili et al., 2020) (Ibáñez-Forés et al., 2018) (Calabrò & Komilis, 2019).

Even if some demographic variables are significant in some of the models analysed, the recycling rate appears not to be too related to economic or social characteristics (average income, average household size, or even population size itself) but to the different policies implemented by the municipalities, the autonomic and state governments and the European Commission.

6. CONCLUSIONS

In this work, 43 variables were analysed with respect to the recycling rate to find out which ones were mostly affected and thus the ones that need to be seriously considered when designing new environmental policies.

The first conclusion is that the most important variable that influence recycling rates is how the waste is collected. Particularly, door to door is the one that most strongly affects any of the methods evaluated. This is interesting because it means that a significant improvement of recycling rate can be achieve in any city independently of its population size.

The second conclusion that can be drown is the effect of the directives approved by the European Commission to increase the recycling rate. The potential fines imposed for not meeting the threshold regulations on the recycling rates have strongly fostered the municipalities to develop policies to be able to comply with these rules.

The third conclusion is that the CVO significantly increases the recycling rate when compared to the other entities. Probably, the fact of achieving scale economy makes it more efficient than its competitors. However, without knowing if the entity is only responsible of collecting the garbage and not involved in the design of recycling policies (such as collecting frequency or number of dumpsters per habitant) hampers the proper rationalisation of its effect into the recycling rates.

The fourth conclusion is that unemployment appears to be significant in the model developed but recycling rate appears not to be that related to economic or social characteristics (average income, average household size, or even population size itself). A deeper social analysis should be carried out but at first sight this result is compatible with the fact that unemployment would similarly affect at all levels of our society and

thus have a neutralizing effect. Nevertheless, and again, one hast to keep in mind that the most influential factors are those related to the different policies implemented by the municipalities, the autonomic and state governments and the European Commission.

And finally, even if it could not be numerically tested, a good environmental education will always be essential to rising the awareness on the population about the importance of the three Rs that are, recycling, reusing and reducing. This is a must if we need to significantly advance on the transition from today's unsustainable linear economy to tomorrow's sustainable circular economy.

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ANNEXES

Annex I

The questionnaire that was sent to the environmental responsible to gather the qualitative information regarding the waste collection.

QÜESTIONARI/ *QUESTIONNAIRE*

1. Quin tipus de sistema de recollida de residus teniu implementat actualment? (recollida porta a porta o convencional)/ *What type of waste collection system do you currently have in place? (door to door collection or conventional)*

2. Des de quin any teniu l'actual sistema de recollida de residus?/ *Since what year have you had the current waste collection system?*

3. Qui es fa càrrec actualment de la recollida? Empresa privada, el municipi mateix, un consorci públic, altres...?/ *Who is currently in charge of the collection? Private company, the municipality itself, a public consortium, others ...?*

4. Quin tipus de sistema de recollida de residus teníeu implementat prèviament? (remuntant-se fins l'any 2000) / *What type of waste collection system did you previously implement? (dating back to 2000)*

5. Qui es feia càrrec de la recollida? Empresa privada, el municipi mateix, un consorci públic, altres...?/ *Who was in charge of the collection? Private company, the municipality itself, a public consortium, others ...?*

6. En cas d'haver canviat de sistema més de dues vegades, podríeu indicar quins sistemes eren, qui se'n feia càrrec i durant quins anys?/ *If you changed systems more than twice, could you indicate which systems were there, who took care of them, and for how many years?*

7. Hi ha o hi ha hagut algun incentiu per fomentar el reciclatge? (per exemple descompte en l'impost d'escombraries per anar a la deixalleria o per fer auto-compostatge...). En cas afirmatiu, podríeu especificar de quin any a quin any i com es materialitza aquest incentiu?/ *Is there or has there been any incentive to encourage recycling? (for example, discount on the garbage tax for going to the landfill or for self-composting ...). If so, could you specify from which year to which year and how this incentive materializes?*

8. S'han fet xarrades/campanyes per motivar el reciclatge? En cas afirmatiu, quin any/anys?/ *Have there been talks / campaigns to motivate recycling? If so, what year / years?*

9. Se t'acudeix alguna informació interessant que no hagi tingut en compte que afecti al reciclatge?/ *Can you think of any interesting information that you haven't considered affecting recycling?*

Annex II

Data set table with all the previous variables gathered and the new variables created from them. Being a data set composed of 39 cross sections and 19 years, 154 columns and 741 rows; the table is impossible to fit in this annex but can be found in the following link:

https://drive.google.com/file/d/1ygCvPE19lkzfrQxXer2n1yXNTcIuZmgn/view

Annex III

String code table for the municipalities' name

1 = 'AIGUAFREDA'

2 = 'AMETLLA DEL VALLÈS, L´'

3 = 'BIGUES I RIELLS'

4 = 'CALDES DE MONTBUI'

5 = 'CAMPINS'

6 = 'CANOVELLES'

7 = 'CÀNOVES I SAMALÚS'

8 = 'CARDEDEU'

9 = 'FIGARÓ-MONTMANY'

10 = 'FOGARS DE MONTCLÚS'

11 = 'FRANQUESES DEL VALLÈS, LES'

12 = 'GARRIGA, LA'

13 = 'GRANOLLERS'

14 = 'GUALBA'

15 = 'LLAGOSTA, LA'

16 = 'LLIÇÀ D´AMUNT'

17 = 'LLIÇÀ DE VALL'

18 = 'LLINARS DEL VALLÈS'

19 = 'MARTORELLES'

20 = 'MOLLET DEL VALLÈS'

21 = 'MONTMELÓ'

22 = 'MONTORNÈS DEL VALLÈS'

23 = 'MONTSENY'

24 = 'PARETS DEL VALLÈS'

25 = 'ROCA DEL VALLÈS, LA'

26 = 'SANT ANTONI DE VILAMAJOR'

27 = 'SANT CELONI'

28 = 'SANT ESTEVE DE PALAUTORDERA'

29 = 'SANT FELIU DE CODINES'

30 = 'SANT FOST DE CAMPSENTELLES'

31 = 'SANT PERE DE VILAMAJOR'

32 = 'SANTA EULÀLIA DE RONÇANA'

33 = 'SANTA MARIA DE MARTORELLES'

34 = 'SANTA MARIA DE PALAUTORDERA'

35 = 'TAGAMANENT'

36 = 'VALLGORGUINA'

37 = 'VALLROMANES'

38 = 'VILALBA SASSERRA'

39 = 'VILANOVA DEL VALLÈS'