The effect of political and economic factors on environmental policies: recycling and waste management policies

Alba Teodoro Pujol
Universitat de Barcelona – UB School of Economics

Advisor

Pilar Sorribas-Navarro
Universitat de Barcelona – UB School of Economics

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Abstract

This study aims to analyze the effect of political and economic factors on the adoption of environmental policies. I focus on the municipal waste recycling policies, particularly on the implementation of the Door-to-Door collection model, which leads to high recycling rates of municipal waste. I build a panel data comprising the period 2000-2019, at the Catalan municipal level. This analysis is based on the hypothesis that women in local politics are more likely to implement stricter environmental policies than their male counterparts, as the adoption of the Door-to-Door collection model. In addition, I analyze the influence of the "green" political parties, as another political factor. Furthermore, I examine whether economic motives, such as the landfill tax, is behind the adoption of this waste collection model. I do not find empirical evidence of any political factor influencing the adoption of the Door-to-Door model. Contrary, I do find a positive effect of the landfill tax on the implementation of the Door-to-Door collection model.

Key words – Female politicians, Selective Waste Collection, Door-to-Door model, Landfill tax, Recycling rate.

"We are either going to have a future where women lead the way to make peace with the Earth or we are not going to have a human future at all."

- Dr. Vandana Shiva, physicist, ecologist, and activist.

1 Introduction

Climate change has become one of the most important challenges in the world nowadays. The greenhouse gases in the atmosphere showed new records in 2019, and the level of CO_2 was 18% higher from 2015 to 2019 than in the previous five years (UN, 2021a). The rise of the average global temperature has increased by 0.85°C from 1880 to 2012. Today the Earth is 1.2°C warmer than in the late 1800s (UN, 2021b). The average sea level increased by 19 cm, and oceans expanded, due to warming and ice melted, between 1901 and 2010 (IPCC, 2013). Moreover, given the current path on emissions of greenhouse gases, it is likely the rise in global temperature would exceed 1.5°C by the end of the century (IPCC, 2018). In this respect, political international agreements come into play to take action against the climate emergency. On one hand, the Paris Agreement, adopted in 2015 by 196 parties, has the ambitious goal to limit global warming below 2°C this century, optimally to 1.5°C, by adopting several coordinated policies (UN, 2015a). On the other hand, in 2015 the United Nations General Assembly approved "The 2030 Agenda". In this, are ratified 17 Global Goals and associated targets, which lead together the new sustainable path intended to be achieved by 2030. Climate action and sustainable consumption patterns are two of the 17 Global Goals (UN, 2015b). Notice, these multilateral agreements help us to understand the importance of the current climate emergency and the need to take coordinated actions among countries. In this sense, politics at all levels are becoming pivotal to implement stricter environmental policies.

Within the global climate action, policies on waste management are considered. These policies focus on targets of reduction, reuse, and recycling of waste. Especially, they focus on municipal waste management aiming for high recycling rates (UN, 2015a; UN, 2015b; EC, 2015; EEA, 2018). The management of waste is understood as a strategic sector in terms of saving global emissions. It is estimated that solid waste management implies around 3% of the global greenhouse gas emissions in 2010, mainly due to landfill sites (UNEP, 2015). However, waste management can potentially contribute to the reduction of global greenhouse emissions across sectors of the economy, calculated as up to 10-15%.[1] Then, it has the capability to mitigate climate change in the short term and reduce emissions across the economy; mainly by reducing landfill disposal, recycling waste, and reducing waste generation (UNEP, 2015). In short, the potential contribution of waste management and recycled waste would lead to a net reduction of global greenhouse emissions across the economy. In this direction, it is globally aimed to follow a more sustainable path in the use of resources; aiming for selective waste collection, reduction of waste generation, and high recycling rates of municipal waste. Thereby, being this the core of this study.

[1] Additionally, it is estimated that the potential contribution of reducing global greenhouse emissions, from the waste management sector, could be up to 15-20% when also included waste prevention and the environmentally sound management of waste (UNEP, 2015).

In the European context, there is also a vast regulation framework to take action against the environmental emergency. Hence, contributing to the commitment of the international agreements and their goals. The European "Plan for the Circular Economy" (EC, 2015) puts the focus on the management of waste and the circular economy.[2] Within this context, the more recent European regulation has built the recycling rate indicator through which was set a target of 50% of municipal waste to be recycled in 2020 in all EU Member States; 55% by 2025, 60% by 2030, and 65% by 2035 (EEA, 2018). In sum, achieving higher recycling rates of municipal waste has become a key objective among environmental policies. The recycled and reused municipal waste should play a key role from now on in the political landscape, directly influencing the lowest level of politics. Thus, it is relevant to analyze its economic and political determinants; what policies are the most effective to meet the recycling rate's targets, and what determines their implementation. In this master thesis, I aim to analyze the political and economic factors that lead to implementing stringent environmental policies related to waste recycling.

The analysis is implemented at the Catalan municipal level. Catalonia is a region of Spain that has the political responsibility to meet the aforementioned international recycling targets (UN, 2015b; EEA, 2018). In this line, Catalonia was the first region of Spain to introduce a landfill tax in 2004. This fact is very determinant for my study, which puts this region very ahead in the recycling policies of municipal waste within Spain. Moreover, in Catalonia, there is the *Agència de Residus de Catalunya (ARC),* a public entity with competence over waste management within its territory. It incentivizes selective waste collection across municipalities, providing public data and studies related to waste management. Then, Catalonia is the only region of Spain in providing highly detailed data, at the municipal level. This data is available from the year 2000 until today, allowing both time-series and cross-section analysis. Given this suitable setting, the data from the 947 Catalan municipalities' allows me to construct a rich dataset and to conduct my analysis.

This study empirically tests political and economic factors that determine the local policies implemented to improve the waste recycling rate. I focus on the selective waste collection of municipal waste, specifically, on the adoption of the Door-to-Door collection model. This model is found as the most effective in achieving higher recycling rates, hence, avoiding or reducing landfill disposal. Therefore, the adoption of the Door-to-Door model becomes the determinant policy of this analysis. Regarding the political scenario, I study whether female representation in local politics leads to adopting the Door-to-Door collection model. I also analyze another political factor, as the influence of the "green" political parties.[3] Finally, I examine if municipalities respond to economic motives such as the tax on landfill disposal.

To conduct the empirical analysis I first implement a Propensity Score Matching (Rosenbaum and Rubin, 1985; Caliendo and Kopeining, 2005; Ho et al., 2007) to select the sample of municipalities to be

[2] The circular economy has the goal to use the resources for as long as possible. By recycling and reusing materials, products and/or waste it attempts to extract the maximum value of them, and to reduce the waste generation. The circular economy aims for a circular use of materials (EC, 2015).

[3] "Green" political parties are identified as those local political parties with a clear commitment with environmental policies within their political beliefs. The identification of "green" parties is discussed in section 3.

used in the analysis. In the end, I obtained a matched sample with nearly identical municipalities. After matching, I proceed with the empirical analysis by using a municipality Fixed Effects model, from which I am able to estimate the causal effects of political and economic factors on the Door-to-Door model. I do not find empirical evidence that female representation nor "green" parties influence the adoption of the Door-to-Door model. Contrary, I do find empirical evidence that the landfill tax positively impacts the implementation of the Door-to-Door model. Consequently, the landfill tax is the only instrument that incentivizes stricter municipal waste policies, rather than political factors.

The findings of this study contribute to the literature primarily in two ways. Firstly, this is the first study that focuses on the municipal level of Catalonia, aiming to analyze the potential effect of female politicians on political outcomes. Within a Spanish context, recent literature has focused on the gender of politicians, mainly studying the effect of gender quotas, introduced in Spain in 2007 and 2011, (Casas-Arce and Saiz, 2015; Bagues and Campa, 2018; Bagues and Campa, 2020). In this study, I do not focus on the gender quotes but the role of female politicians in the municipal councils and their effect on the environmental policies of waste management. Hence, I study the role of women in politics from a different perspective than the studies above. Secondly, this master thesis set as a central point the municipal waste management. It considers the current global fight against climate change focusing on the local political actions (Sundström and McCright, 2014; Frederiksson and Wang, 2011). At the same time, this is linked with the international political lines from the climate agreements (UN, 2015a; UN, 2015b; EC, 2015; EEA, 2018). Then, this is the first study that analyzes the political factors behind the adopted municipal environmental policies, given the current climate emergency and the suitable Catalan setting.

The rest of this master thesis is structured as follows. Section 2 shows the literature review and the contribution of this study. Section 3 exposes the institutional and political setting. Section 4 describes the main features of municipal waste management in Catalonia. Section 5 introduces the database and the summary statistics. Section 6 details the empirical strategy. Section 7 presents the results and the validation of the empirical strategy. Finally, section 8 concludes.

2 Literature review

This master thesis is based on two main assumptions from economic literature. The first hypothesis assumes that the gender of politicians may influence the final political outcome. The under-representation of women in politics is a common feature shared by all democracies around the globe.[4] Hence, a growing economic literature has studied the rise of female representation and their leadership in politics. Under the assumption in which the identity of the politician matters for policy decisions (Osborne and Slivinski, 1996; Besley and Coate, 1997), the role of female representation may influence the political outcome. Then,

[4] On a worldwide view; in 2020, women served as a Head of State or Head of Government in only 22 countries (UN Women, 2020) and just around 25% of seats of the World's national parliaments were held by women (World Bank, 2020).

putting the focus on gender, it is found that female politicians are expected to implement more policies that are relevant for women's needs; regarding social care, education-children, basic public good-needs (Chattopadhyay and Duflo, 2004; Clots-Figueras, 2011), or higher spending on health policies (Bhalotra and Clots-Figueras, 2014).

Following this line, and given the huge gender gap in political representation, gender parity has become a desired worldwide target to be achieved.[5] In recent years a large number of countries have implemented various types of electoral gender quotas, fighting the unbalanced representation between genders in political life (International IDEA, 2021). Consequently, economic literature has also focused on the study of the introduction of gender quotas in politics. The rise in quality among politicians is a result derived from the introduction of gender quotas (Baltrunaite et al., 2014; Besley et al., 2017). Also the increase of female leaders (O'Brien and Rickne, 2016) or the change of voters' behavior (Beaman et. al. 2009; De Paola et al., 2010; Beaman et. al., 2012). Additionally, Baskaran and Hessami, (2018) report, using data from Germany, the effect of raising the share of female council members when a female mayor has been previously elected.

Considering the above, the second main assumption of this study is that women politicians are more likely to implement stringent environmental policies than their male counterparts. Previous literature has reported differences in attitudes towards the environment, suggesting that females are more concerned than males about climate change (McCright, 2010; McCright and Dunlap, 2011). There are also stated gender differences in the mitigation strategies against environmental issues and climate change (EIGE, 2016). In this sense, it has introduced the gender dimension when making environmental policies at a European and more international level (EIGE, 2013; EIGE, 2016). Furthermore, literature also studied the role of female politicians in the adoption of environmental policies. Women show more environmental concern in the lowest level of politics but do not find evidence in the Swedish national parliament (Sundström and McCright, 2014). In the US House of Representative's context, it is found that women legislators support stricter environment policies than men legislators (Frederiksson and Wang, 2011). More recently, Mavisakalyan and Tarverdi (2019) find that female representation entails the national parliaments to approve stricter environmental policies regarding climate change than men, considering a vast sample of countries. Additionally, Ramstetter and Habersack (2020) analyze the gender differences towards environmental policies among Members of the European Parliament. Female legislators are more likely to support pro-environment policies than their male counterparts.

This master thesis focuses on municipal environmental policies regarding waste recycling (Romano et al., 2019; Soukiazis and Proença, 2020). In my case, the selective waste collection and the implementation of the Door-to-Door model are the subjects of the study. Hence, female presence in Catalan municipal councils might drive stringent environmental policies than their male counterparts, by adopting the Door-to-Door collection model. Additionally, I also analyze another political factor, such as the representation of

[5] In 2015, within the context of the Sustainable Development Goals from "*The 2030 Agenda"*, it was approved the Global Goal 5:*"Achieve gender equality and empower all women and girls. (…) ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life."* (UN, 2015b).

"green" political parties. Finally, I study whether the economic effect of the landfill tax leads to adopting stringent environmental policies. So, the municipalities would respond to economic motives, given the design of this tax and the direct influence on the municipal budgets. The landfill tax discourages landfill disposal and so, promotes the implementation of selective waste collection (ENT, 2012; OFR, 2019).

3 Institutional background: Spain and Catalonia

This section describes the political and institutional context of Spain and Catalonia, including the municipal electoral system, the introduction of legislated gender quotas, and the jurisdiction of the municipal councils, being the waste management a municipal competence. Also, it exposes the situation of female representation in local politics, the social attitudes on environmental issues, and describes the "green" parties' identification.

I) Spain

Basic institutional setting. In Spain, the Spanish Constitution[6], from 1978, shapes the current institutional and political organization of the country. The Prime Minister is the head of the executive power and the President of the Government. Then, the central government has all powers ultimately vaster. However, some competencies are transferred to lower levels of government in the country. The institutional organization of Spain in its territorial dimension includes seventeen Autonomous Communities and two Autonomous Cities, with their respective governments and autonomy. Therefore, there are three layers of government in the country: the central government, the regional governments, and the municipal governments.

Municipal electoral system. The municipal governments are the lowest level of administration and political decisions in Spain. Every four years municipal elections are held and the municipal council members are directly elected by their voters. The municipal electoral system, regulated by *Ley Orgánica 5/1985,* differs depending on the population. Municipalities with less than 250 inhabitants follow an open-list system, and municipalities with more than 250 inhabitants follow a closed-list and proportional electoral system. As well, the distribution of the number of seats in municipal councils (from municipalities with 7 seats to a maximum of 41 in Barcelona, in the case of Catalonia) depends on the population. Moreover, the municipal electoral system also considers the so-called "*D'Hondt Rule",* which determines the allocation of seats from the votes obtained. Also, it requires a 5% of vote share for entry into the municipal council[7]. In the end, following the majority rule, the mayor is elected by the municipal council. Hence, the municipal governments are constituted by the same municipal council, and the mayor is the political leader.

[6] See details *The Spanish Constitution* [online] Available at:: https://www.boe.es/legislacion/documentos/ConstitucionINGLES.pdf

[7] See details *Ley Orgánica 5/1985* [online] Available at: https://www.boe.es/buscar/act.php?id=BOE-A-1985-11672

Municipal jurisdiction: municipal waste management. In Spain, there is a distribution of competencies on waste management among the central government, the regional governments, and the local governments. This division of responsibilities through the three political levels is regulated by *Ley 10/1998*.[8] In this sense, the Spanish central Government has competencies in the development of national waste plans. The Autonomous Communities (or regional governments) have competencies in the preparation of the regional waste plans. They are also responsible for the authorization, control, inspection, and penalty of waste generation and waste management activities. Finally, the local governments have competencies in the management of urban/municipal waste, and are also under regional regulation. Therefore, municipalities are responsible for the collection, transportation, and at least, the elimination of municipal waste, as an essential service.

Following the definition form (OECD, 2021), municipal waste is the waste that is collected and treated by or for municipalities. It does not include waste from municipal sewage networks and treatment, nor waste from demolition and construction activities. In Spain, the *Decreto Legislativo 1/2009* defines municipal waste as the waste generated in private homes, shops, offices, and services. Also, all waste that is not considered hazardous, and the one from cleaning public roads, green areas, recreational areas, and beaches; dead domestic animals; furniture, utensils, and abandoned vehicles; waste and rubble from minor building works and household repairs.[9]

Introduction of legislated gender quotas. The use of legislated gender quotes is increasing worldwide. These are designed to increase female participation in political life (International IDEA, 2021). By using numerical targets, gender quotas aim to ensure women constitute at least a significant share of the total seats[10]. In Spain co-exist two kinds of gender quotas; the legislated quotas under the Spanish Equality Law, *Ley Orgánica 3/2007,* and the voluntary quotas adopted by some political parties. Note in this study, I focus on the legislated gender quotas. In Spain, in March 2007 the Equality Law[11] was approved modifying the current Spanish electoral law. Since 2007, all party electoral lists are required to have a minimum of 40% and a maximum of 60% of either sex among their candidates list every five positions. In 2007, this rule was applied to municipalities with more than 5000 inhabitants. By 2011, this Equality Law was extended and just municipalities with less than 3000 will not be obligated to follow the equality rule. As stated, the quotas are not only applied to the whole party list but also every 5 posts. If the number of eligible posts is less than 5, then the list must be as close as possible to the 40-60% equilibrium between genders (International IDEA, 2021).

[8] See details *Ley 10/1998* [online] Available at: https://www.boe.es/buscar/doc.php?id=BOE-A-1998-9478

[9] Definition included in *Decreto Legislativo 1/2009* [online] Available at: https://www.boe.es/buscar/act.php?id=BOE-A-2009-17181

[10] The objective of the quota system is to ensure that women constitute a large minority of 20, 30, or 40% of the political seats. Also exists the 50% quota, ensuring the true gender balance. The average share of female representation in countries with implemented quotas is 26.8% (International IDEA, 2021).

[11] See details *Ley Orgánica 3/2007* [online] Available at: https://www.boe.es/buscar/act.php?id=BOE-A-2007-6115

Female participation in Spanish politics. In the same direction as the vast European countries, women in Spain are under-represented in all political levels: in the Spanish national Parliament, the share of seats held by women has risen considerably in the last two decades. In 2000, 28% of seats in the national parliament were held by women (Fernández, Fernández and de Ulzurrun, 2003). This number rises to 44% by 2020 (EIGE, 2021). Currently, Spain has one of the most gender-balanced parliaments in the European Union, being this 44% noticeably higher than the European average, 32.3%.[12] Nevertheless, no woman has ever been Prime Minister in Spain, yet.

At the local level, the situation follows the same direction as the national parliament. In the last two decades, female representation has also increased. In 2000, 21% of seats were held by women. By 2020, it was 40.8% (EIGE, 2021). This last share is larger than the European average, 34.1%,[13] but still far from full parity. Regarding the gender of the mayor in municipal councils, the over-representation of men is more remarkable. In 2000, 9.6% of the mayors in Spain were women. Only 21.7% were female mayors by 2020 (EIGE, 2021). Hence, illustrating the huge underrepresentation of female leaders in Spanish politics.

Social attitudes on climate change and recycling domestic waste. In Spain, differences among genders are reported when looking at social attitudes on environmental issues. It is stated 78.5% of women consider the environment as a major concern, and 75.2% of men. Moreover, 10.2% of women declared to suffer problems due to pollution and other environmental issues, the 9.6% for men (INE, 2008; INE, 2019).

As particularly concerns the municipal waste, (Ipsos, 2019) provides a social barometer reflecting Spaniard's opinion on the environment and recycling the domestic waste in 2019. This shows a higher tendency of women in recycling domestic waste than men.[14] When asking about the importance of recycling domestic waste as a positive impact on the environment; 96% of women and 92% of men agree. Regarding the change of behavior, in consumption and generation of domestic waste, it is reported that women are the most conscious aiming to reduce the environmental impact than men.[15] Overall, this social barometer reflects women are more likely to take action against climate change in Spain. Moreover, women seem to be the key player in most domestic actions such as recycling municipal waste.

II) Catalonia

Basic institutional setting. Catalonia is one of the seventeen Autonomous Communities of Spain. The Catalan Government exercises its self-government following the Spanish Constitution and with the new

[12] Members of parliament or assembly: 32.3% of female seats in 2020 (Q1), EU-28 average (EIGE, 2021).

[13] Members of the municipal council (or equivalent): 34.1% of female seats, in 2020, EU-28 average (EIGE, 2021).

[14] Recycling domestic waste according to sex: Women: plastics; 83%, glass; 83%, paper, 83%, organic waste, 63%. Men: plastics; 81%, glass; 80%, paper; 79%, organic waste; 61% (Ipsos, 2019).

[15] 91% of women prefer products with less plastic packaging, and 73% of women don't use plastic bags when grocery shopping. For men, these percentages are 87% and 67%, respectively (Ipsos, 2019).

Catalan Statute of Autonomy[16], approved in 2006. In Catalonia, there are 947 municipalities in 2019, which their municipal governments constitute the lowest stage of political decision. Catalan municipalities are under the same municipal electoral system that Spain, regulated by *Ley Orgánica 5/1985*. Hence, Catalonia is also subject to the Spanish Equality Law, *Ley Orgánica 3/2007,* and to the introduction of legislative gender quotas in 2007 and 2011 (see above).

Municipal jurisdiction: municipal waste management. As exposed above, the distribution of competencies on waste management among the three levels of governments is regulated by the Spanish law, *Ley 10/1998*. Therefore, Catalan municipalities have competencies in the management of urban/municipal waste, and also under the Catalan regulation. They are responsible for the collection, transportation, and elimination of municipal waste. Hence, it includes selective waste collection and municipal recycling policies.

The current climate emergency has put the focus on environmental policies, also at the local level of politics. The management of municipal waste has become a central point, being the local politicians who must take action on it.

The *Agència de Residus de Catalunya*, hereafter ARC, is a Catalan public entity responsible for disseminating the environmental policy targets of the Catalan government and local governments. Hence, this public agency has jurisdiction over the waste generated and managed in Catalonia (ARC, 2021). The main goals of the ARC are the protection of the environment and the improvement of the quality of life of citizens. As its specific objectives, the promotion of selective waste collection and the minimization of waste generation are the main ones (ARC, 2021). Note the Catalan policy targets are in the same line as the international objectives subject to (UN, 2015a; UN, 2015b; EC, 2015; EEA, 2018).

The ARC plays a fundamental role in this study. Firstly, it shows Catalonia very ahead in terms of awareness of environmental impacts from waste management and in recycling policies. In this regard, since 2005, every year several campaigns have been conducted by this public entity. The main goal of these campaigns is to reach the Catalan society on specific topics; such as the proper selection of municipal waste, the importance of recycling and reducing waste, or the reuse of resources (ARC, 2021). Moreover, Catalonia is the first region of Spain to introduce a landfill tax in 2004 (see details in section 4). This economic instrument aims to incentivize selective waste collection models, rather than landfill disposal. In the design of this instrument, the ARC plays a determinant role (ARC, 2021).

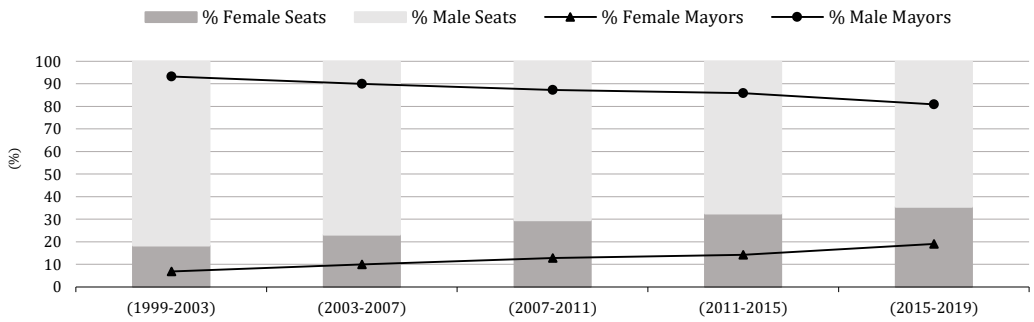
Besides, Catalonia is the only region of Spain in providing highly detailed data, at the municipal level; on waste generation, on recycling rates of municipal waste, and selective collection waste. This data is publicly shared by the ARC, together with the Catalan Government. It shows updated data allowing for a European comparison on specific targets; such as the recycling rate of municipal waste.

[16] See details *Llei Orgànica 6/2006* [online] Available at: https://boe.es/buscar/act.php?id=BOE-A-2006-13087

Female participation in Catalan politics. In Catalonia, the under-representation of female seats in regional and local politics is in the same line as in Spain. In 2000 the share of female seats in the Catalan parliament was 25%. By 2020 this share was 43.7% (Direcció d'Estudis Parlamentaris, 2021). This last percentage is also higher than the European average in 2020, 32.3%, and almost identical to the Spanish national parliament, 44% (EIGE, 2021).

At the Catalan municipal level, the situation is also very similar. In the last two decades, female participation has risen considerably. In 2000 the share of female seats in municipal councils was 18.3%. By 2020 this was 42% (ICPS, 2020). However, when looking at the gender of mayors the under-representation of women is even more sizable. In 2000, the share of female mayors was only 6.8%. In 2020, 23% of Catalan mayors were females (ICPS, 2020), showing a considerably unbalanced situation between genders in political leadership. Figure 1 shows the evolution of female representation in municipal politics in Catalonia. It includes the period considered in the analysis, from 2000 to 2019.

Figure 1: Female representation in Catalan municipal politics. Period 2000-2019



Notes: % Female (Male) Seats: share of seats held by women (men) in Catalan municipal councils, once they are constituted after the election. % Female (Male) Mayors: share of municipalities that have a female (male) mayor, once municipal councils are constituted. The variables include the totality of Catalan municipalities. There are five municipal election periods (1999-2003, 2003-2007, 2007-2011, 2011-2015, and 2015-2019).
Source: Own elaboration based on data from (ICSP, 2020).

From Figure 1 it is observed the share of female seats, at the local level, has continually increased in the twenty years considered. However, being still far from the full gender parity, particularly considering female leaders. In other words, it is shown an over-representation of men across Catalan municipal councils. This study aims to test whether the female presence in local politics influences the adoption of stringent environmental policies on municipal waste management, such as the implementation of the Door-to-Door collection model. Then, the representation of women in local politics provides key variables for the analysis.

Identification of "green" political parties. This master thesis also aims to study the influence of "green" parties on the adoption of environmental policies regarding municipal waste recycling. I identify as "green" parties those local parties that are politically committed to the protection and preservation of the environment, according to their founding statutes and ideology. I base this identification on the "*Diccionari dels partits polítics de Catalunya, segle XX*" (ICSP, 2000). This is a dictionary that builds an exhaustive census of

all political parties that were created in Catalonia during the 20th century. Additionally, given the last fifteen years, the political scene in Catalonia has changed considerably, and new parties have been founded and not reported by (ICSP, 2000). Thus, for the identification of the newest parties I used their own political statutes[17].

The identification is done for parties that have representation at the local political scope of Catalonia between 2000 and 2019. I build a binary dummy variable which equals one when the political party is identified as a "green" party, and equals zero otherwise. This builds another set of key variables of this study.

4 Management of municipal waste

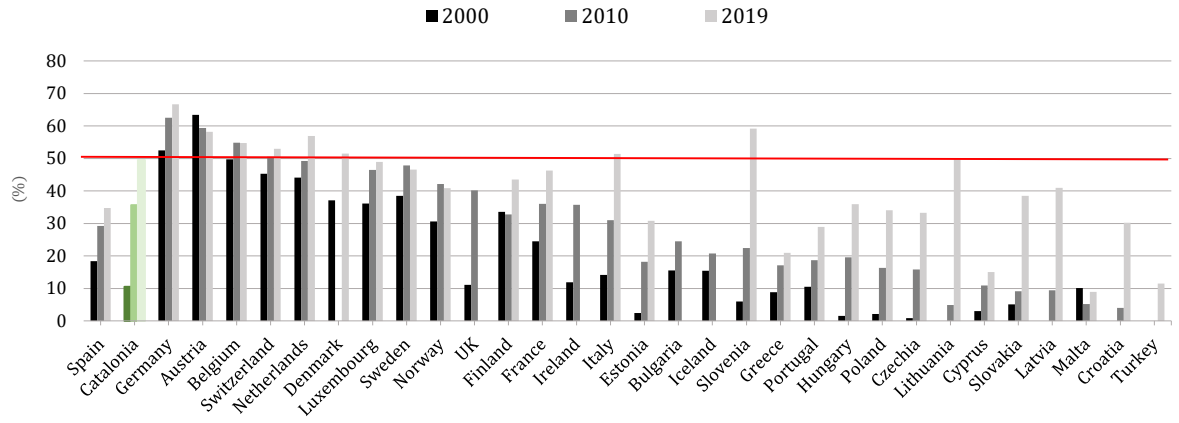
This section describes the selective waste collection in Catalonia and its specific models, being the Door-to-Door model one of them. It also presents the recycling rate indicator and describes the European recycling objectives. Finally, it exposes the landfill tax and its central role in municipal waste management in Catalonia.

Recycling Rate of municipal waste. This indicator measures the share of recycled municipal waste in the total municipal waste generation (Eurostat, 2021). The goals of recycling policies are to augment the recycling rate, extract more value from the resources used, and reduce the environmental impact associated with waste management. Thus, there are two ways to increase this rate; by increasing the recycled municipal waste and by reducing the municipal waste generation. This indicator is built in the context of European environmental regulation. Regarding municipal waste management, two European plans were created within the last decade: the "7th Environment Action Program" (EC, 2014) and the aforementioned "Plan for the Circular Economy" (EC, 2015). Both established general objectives and specific targets to be met by each EU Member State. Among them, the targets on recycling rate of municipal waste were stated: 50% of recycling rate by 2020; 55% by 2025; 60% by 2030; and 65% by 2035 (EEA, 2018). Considering this setting, I build Figure 2, from which I show the evolution of municipal waste recycling in a European comparative.

Therefore, Figure 2 illustrates the recycling rates in 2000, 2010, and 2019 for the European countries and Catalonia. I observe an increase, over time, in the recycling rate of municipal waste across countries. However, notice that less than half of the countries from the illustration have reached the 50% target in 2019, one year before the target was scheduled. On the other hand, the evolution of Catalonia in terms of the recycling rate is; 10.5% in 2000, 35.6% in 2010, and 49.5% in 2019. These are higher rates than Spain in the last decade and are very close to the objective of 50%. In addition, 405 out of 947 Catalan municipalities have already achieved this target by 2019 (ARC, 2021). Overall, Catalonia demonstrates good performance in terms of recycling municipal waste as a region, in the European context.

[17] Amongst the main Catalan parties: *Ciutadans, Catalunya en Comú-Podem (*before, *Catalunya sí que es pot*) and *Junts per Catalunya* have been founded after the publication of (ICSP, 2000). All of them have representation at national and local political level nowadays.

Figure 2: Recycling rate of municipal waste (%). European countries and Catalonia. Period 2000-2019



Note: In green, it includes the data for Catalonia. The red line indicates the European target of 50% of the recycling rate, to be met in 2020. The data missing in the figure is due to "data not available" in the given year by (Eurostat, 2021).
Source: Own elaboration based on data from "Recycling rate of municipal waste (%)" (Eurostat, 2021) and data from (ACR, 2021).

Selective waste collection. As introduced in section 1, the management of municipal waste and its impact on the environment makes this sector very strategic. Selective waste collection refers to the classification of municipal waste in various types: organic waste, glass, plastic/containers, and paper/cardboard. And also the rest fraction, which is the waste from the domestic and commercial use that cannot be selected for either of the fractions above. The main objective of selective waste collection is to recycle the maximum of the generated waste (ARC, 2021). In Catalonia, municipal selective waste collection is mandatory, following the Catalan law[18]. In this sense, I build Figure 3, which summarizes the four main modalities of selective waste collection used in Catalonia and their main characteristics. Each model has its own advantages and drawbacks, in terms of costs of installation, impact on public streets, or effectiveness on recycling targets, among others (ARC, 2021). Therefore, a comparison between them is rather complex. Note the modality of Surface Containers is the most widely used in Catalonia, followed by the Door-to-Door model.

The decision on the implementation of the model is made by each municipal council. It responds to the urban characteristics of each municipality (ARC, 2021), but it is also likely to depend on the demographic characteristics of each municipality, like population or density of population (Puig-Ventosa et al., 2013; Romano et al., 2019; ARC, 2021). Moreover, political factors could also play a role in the decision, as this study aims to analyze. Additionally, economic incentives are likely to influence (ENT, 2013). Overall, given the European objectives on recycling municipal waste, selective waste collection has become essential. In this line, some studies focus on one specific model, the Door-to-Door collection model. This is reported as the best in achieving the highest recycling rates, in Catalonia (ENT, 2012; APAP, 2021). And this is the policy core of my study.

[18] See details *Decreto Legislativo 1/2009* [online] Available at: https://www.boe.es/buscar/act.php?id=BOE-A-2009-17181

Figure 3: Summary of modalities of selective waste collection in Catalonia

Name	Use of containers by type of waste	System
Surface Containers	Yes. On the streets or in drop-off areas.	The containers are emptied periodically.
Buried Containers	Yes. Installed below the ground level.	Drop boxes and elevation system.
Door-to-Door	No.	Each household leaves the waste outside of its front door, on accorded days and hours. The municipal collectors collect the municipal waste from the streets, *door to door*, following the accorded schedule.
Pneumatic	No.	Drop boxes connected to an underground suction point.

Source: Own elaboration based on information from (ARC, 2021)

Door-to-Door collection model. Among the four main models of selective waste collection, this study focuses on the Door-to-Door model, hereafter DtD model. This requires, previously sorted out in origin, to let the waste in front of the households' door to collect by municipal service. There are predefined days and hours for each type of waste to be collected. It is stated that this model works when, at least, organic and rest waste are collected. Nevertheless, it also allows for the other fractions of waste; as paper-cardboard, plastic packages, and/or glass (APAP, 2021).

Probably the most particular feature of this model, and also the biggest challenge, is the implicit change of habits for the citizens which are subject to. At present, the DtD collection model is not the most applied across municipalities in Catalonia. However, the number of municipalities that have adopted the DtD model is continuously increasing over time. In 2000, only 3 municipalities had implemented the DtD model. By 2019, 212 municipalities had the DtD model[19]. Moreover, the DtD model can be implemented totally or partially, depending on the population which is subject to the model. This fact allows for a gradual implementation of the model into the municipality. It is stated this is the only collection model able to reach high recycling rates; it reduces waste generation, and at the same time, increases the recycled municipal waste (ENT, 2012; APAP, 2021). The adoption of this model is the determinant policy in my analysis, being the most effective in terms of positive impacts on the environment, regarding recycling waste.

Furthermore, it is worth mentioning that in Catalonia, the *Associació de municipis catalans per a la recollida Porta a Porta (APAP)* plays an important role while encouraging municipalities to implement this specific model. At the same time, it publishes reports and evaluations of the implementation of the DtD model, in terms of its effectiveness or costs (ENT, 2012; ENT, 2013; APAP, 2021). Moreover, it provides public data, such as this study is based on.

Landfill Tax. Catalonia introduced in 2004 a tax waste, called landfill tax, for the disposal of non-hazardous municipal waste in legal landfills (ARC, 2021). This economic instrument was introduced by the Catalan government with two specific intentions; 1) to penalize the landfill disposal and 2) to reward the amount of selective waste collection and the quality of recycled waste. Then, this tax aims to incentivize selective waste

[19] This data refers to the DtD collection model on the organic waste fraction, at least (APAP, 2021).

collection and so, to increase the recycling rates (ARC, 2017). In other words, as more selective waste collection and better the quality of this, the less the municipal council has to pay in the end as a tax (it will receive a higher reward). The landfill tax, given its design, is expected to have a notorious impact on the management of municipal waste through municipal budgets. Hence, the evolution of the Catalan landfill tax is also important to analyze since the last decade has risen noticeably, directly affecting the municipal budgets. In 2004 the landfill tax was 10€/t, by 2019 it was 41.3€/t, and it is expected to keep increasing to 71.6€/t by 2024 (ARC, 2021).

Catalonia was a pioneer region in Spain when it introduced the landfill tax in 2004. Until 2012 any other region of Spain had introduced any tax on landfill disposal, in 2012 Castilla y León implemented a landfill tax (Watkins et al., 2012). Nowadays, in Spain, there are still some regions that do not have any tax on landfill disposal.[20] Contrary, in the European context the first landfill tax was introduced in 1987 in Denmark and followed by several countries over the years (Watkins et al., 2012). In 2020, in the EU-27, 23 member states have a landfill tax (CWEWR, 2020). In this direction, the European environmental regulation beyond 2020 includes; from 2030, a ban on landfilling of waste suitable for recycling, and a target to reduce landfill to a maximum of 10% of municipal waste by 2035 (EEA, 2018).

5 Data

This section describes the data sources of the variables of the analysis. It also presents a summary of statistics and a description of the variables of interest. I constructed panel data of 947 Catalan municipalities, for the period 2000-2019.

I) Data sources

Municipal Waste Database. I obtained data on municipal waste from the open database of the *Agència de Residus de Catalunya* (ARC, 2021), which collects highly detailed information at the municipal level of Catalonia. It includes the recycling rate of municipal waste and it also provides data on the landfill tax. Regarding the implementation of the Door-to-Door collecting model, I used a database provided by the *Associació de Municipis Catalans per a la Recollida Porta a Porta* (APAP, 2021). In this, it is shown which municipalities have implemented the Door-to-Door system. This data is collected from 2000 on.

Municipal Political Database. The election results of Catalan municipal elections are provided by the open database from the *Generalitat de Catalunya* (Gencat, 2021). Moreover, the data on local politicians such as gender, party, and political post is obtained from the *Institut de Ciències Polítiques i Socials* (ICPS, 2021). Also, I identify the political parties committed to the environment by using the political dictionary (ICPS, 2000). These mentioned sources are complemented with data from *Ministerio del Interior* (Ministerio del

[20] Regions of Spain (Autonomous Communities) without landfill tax on the Municipal Solid Waste in 2019: Andalusia, Aragon, Asturias, Balearic Islands, Basque Country, Canary Islands, Castilla la Mancha and Galicia (CWEWR, 2020).

Interior, 2021). Notice that municipal elections in Catalonia are held every four years. Hence, there are included the municipal elections from 1999, 2003, 2007, 2011, and 2015. Finally, these sources also provide the data for the political control variables used also in the analysis.

Socio-demographic Database. I obtain data from the *Institut d'Estadística de Catalunya (IDESCAT)* for the socio-demographic control variables, at the municipality level. It is complemented with the open database from the *Generalitat de Catalunya* (Gencat, 2021).

II) Variables and summary statistics

The outcome of interest in this study is in terms of the recycling rate of municipal waste and the DtD collection model. For the first indicator, I use the variable $Recycling\ Rate$, which is the share of recycled municipal waste in the total municipal waste generated. For the DtD model, I construct a binary dummy variable, DtD, which equals to one when the municipality has implemented the DtD model and equals to zero otherwise.

Regarding the variables of interest, one political factor subject of this study is female representation in Catalan municipal politics. To examine this, I create two new variables. First, the share of seats held by women in the municipal council, $Share\ of\ Female\ Seats$. This is the ratio between the number of seats held by female politicians in the municipal council and the number of the total seats of the municipal council. Second, I build a binary dummy variable which equals one when the mayor is a woman and equals zero if the mayor is a man, $Female\ Mayor$. In Spain, the mayor of a municipal council is who has ultimate power in the local government, hence, it is expected to influence. However, as shown in Section 3, only around 20% of mayors in Catalonia are women in 2019. Therefore, I also include into the study the share of seats held by women, which can also have potential influence, as members of the municipal council.

On the other hand, I also examine the representation of "green" parties in local politics. In this sense, I build two more variables; one is the share of "green" seats in the municipal council, $Share\ of\ Green\ Seats$. This is defined as the ratio between the number of seats of the municipal council held by politicians who belong to a "green" party and the number of the total seats of the municipal council. The other one is a binary dummy variable which equals to one when the mayor belongs to a "green" party and equals to zero otherwise, $Green\ Mayor$. As before, I use these two variables to show the representation of the "green" local parties in the municipal council. Finally, I also aim to study the economic effect of the tax on landfill disposal, $Landfill\ tax$, which is the yearly amount established for the tax on landfill disposal for the Catalan Government, defined in terms of €/tonne.

Table 1 presents the summary statistics of these main variables. Note Table A.1 in the Appendix shows the summary statistics of the political control variables and the socio-demographic control variables used in the analysis.

Table 1: Summary statistics of the main variables

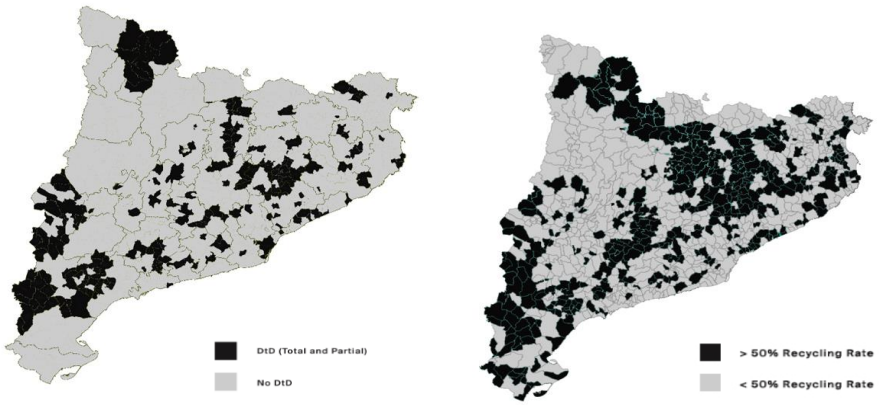
Variable	Mean	Standard Deviation	Minimum	Maximum
DtD	0.091	0.287	0	1
Recycling Rate	30.264	18.459	0	100
Female Mayor	0.124	0.330	0	1
Share of Female Seats	26.213	20.234	0	100
Green Mayor	0.162	0.3692	0	1
Share of Green Seats	21.816	24.772	0	100
Landfill Tax	13.385	11.001	0	41.3

Figure 4 shows two maps of Catalonia in 2019. On the first map (left) are illustrated, in black, the municipalities that have implemented the DtD model. There are 212 Catalan municipalities highlighted. The second map (right) shows the municipalities which have reached a 50% recycling rate in 2019. There are 405 municipalities in black. From Figure 4 it can be seen that most of the municipalities that have already implemented the DtD model, by 2019, have reached the 50% recycling objective. This could suggest the effectiveness of the DtD collection model in terms of recycling rates. Nevertheless, this is still an initial suggestion.

On the other hand, Figure 5 shows two graphs. On the left, the number of municipalities which adopted a selective waste collection, from 2000 to 2019. It also includes the year of the introduction of the landfill tax. The graph on the right shows two variables: the number of municipalities that implemented the DtD collection model and the evolution of the amount of the landfill tax, both variables comprise the period from 2000 to 2019. From Figure 5 two features can be observed. Firstly, the adoption of selective waste collection has risen considerably in the last twenty years in Catalonia. The municipalities under and over 5000 inhabitants seem to follow different patterns on the decision to implement selective waste collection. This fact would suggest population could play a role in the introduction of waste management policies at the local level (ARC, 2021). Secondly, I see that the evolution of the landfill tax and the evolution of municipalities with the DtD model follow a similar pattern. Hence, this tax could be determinant in the adoption of the DtD model. However, these are only initial suggestions.

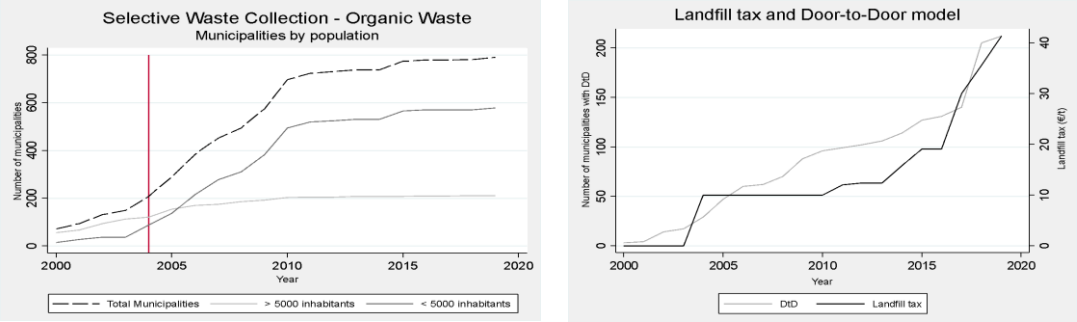
One relevant comment here is regarding the data on the Catalan landfill tax. The data used in this study is provided from (ARC, 2021), which tells the amount established for the tax each year, in terms of €/t. Then, this amount is the same for all municipalities. Nevertheless, the design of this tax is the key feature of this instrument; it allows municipalities to pay more or less, through a reward or penalization, depending on several indicators such as the quality of the selective collection, the amount of recycling rate, or treatment of the waste after collection, among others. In other words, each municipality pays a different final amount depending on how good (or bad) its municipal waste management is, as regards the environmental impacts (ARC, 2017). However, there is no publicly available data on how much each municipality pays at the end for the landfill tax. Rather, I use the general amount of this taxation, in €/t, in this analysis.

Figure 4: Map of municipalities of Catalonia with the implemented Door-to-Door model in 2019 (left). Map of municipalities of Catalonia with more than 50% of recycling rate in 2019 (right)



Notes: Map on the left: in black, municipalities of Catalonia which have adopted the DtD model by 2019. The map on the right: in black, municipalities of Catalonia that have reached the 50% recycling rate of municipal waste by 2019.
Sources: Map on the left: Own elaboration replicating "Map of municipalities with implemented Door-to-Door system in Catalonia by February 2019", based on data from (APAP, 2021). The map on the right: Own construction replicating figure based on a dataset from (ARC, 2021).

Figure 5: Evolution of selective waste collection and DtD model. Relation with the landfill tax



Notes: Left side graph: shows the number of municipalities that collect the organic waste separately, called the selective waste collection. This is regardless of the model on the selective waste collection implemented. The red line indicates the introduction of the landfill tax in 2004. The right side graph shows the evolution of the amount of landfill tax per year (black line) and the number of municipalities that adopted the DtD model (gray line).
Source: Own elaboration based on data from (ARC, 2021).

6 Empirical strategy

This section describes the empirical methodology employed to study the political and economic factors that affect the adoption of the DtD collection model. Firstly, the baseline model is exposed. Secondly, I describe the Propensity Score Matching strategy and the final specifications, aiming for a causal-effect estimation.

I) Baseline Model.

Fixed Effects specification: the Recycling Rate. I employ a Fixed Effects model in which the recycling rate indicator is my dependent variable. Then, I estimate the following specification (1):

$$RecyclingRate_{it} = \theta_1 DtD_{it} + \Omega X'_{it} + \mu P'_{it} + \eta_i + T_t + \upsilon_{it} \quad (1)$$

where i is a Catalan municipality in year t. The DtD is the dummy variable telling on the adoption of the DtD collection model. Moreover, X' is a set of socio-demographic control variables, and P' is a set of political control variables. Municipality fixed effects, η, and time fixed effects, T, are included. Municipality fixed effects capture time-invariant municipality characteristics. Time fixed effects control for unit-specific effects due to time, then capture varies over time but is common to all municipalities. Note, I follow a sequential analysis from which I aim to analyze the main elements that explain the recycling rate across municipalities. Thus, I introduce each variable consecutively (see Table 2).

The set of socio-demographic control variables, X', includes variables on population, density, and area, for each municipality and year. Also, the age structure of the population, divided into three groups; from 0-14 years old, from 15-64 years old, and from 65 years old on. Moreover, the level of education of the population, divided into five groups: Illiterates, No Education, Primary Education, Secondary Education, and High Education. And the share of foreigners. Finally, the number of municipal green associations per capita. On the other hand, a set of political control variables is also added, P', controlling for the re-election of the mayor, the majority of the seats, and the political ideology of the municipal council, in terms of the share of left-wing seats. The coefficient of interest, θ_1, captures the relationship between the DtD model and the recycling rate of municipal waste. This is the subject of this analysis.

Note the model (1) sets up the first part of the study. I examine which elements influence the recycling rate of municipal waste in Catalonia. I found the coefficient θ_1 is the highest, and its effect is positive and statistically significant (see section 7). In other words, the DtD model is the main determinant of the recycling rate of municipal waste, and then, the key variable to be studied from now on. Therefore, model (1) confirms that the implementation of the DtD collection model is the core policy of this study; so, my goal is to analyze the political and economic factors that determine the adoption of the DtD model.

However, one empirical concern arises here. The DtD model is found as the key municipal policy. Nevertheless, this collection model is not vastly used among municipalities; in 2019 only 212 municipalities, out of 947, had adopted the DtD model. Intuitively, the adoption of this collection model is not random, neither in space nor regarding socio-demographic municipal determinants. Hence, leading to an empirical issue on the selection of observables into the DtD collection model.

Considering the above, I employ a matching procedure to deal with the selection of observables, on my original sample, of municipalities with the DtD model and without the DtD model. The selection of the sample is performed by using the "propensity score" matching. Then, I am able to obtain a sample with nearly identical municipalities. And the only distinction among them being the adopted (or not) DtD model. The identification strategy of this study relies on the fact that, prior to matching, there are differences in socio-demographic characteristics among municipalities that have the DtD model and that do not adopt the DtD model. So, implying an unbalance in the observations of the original sample. Conversely, after

matching, this unbalance is corrected. Hence, with the selected sample through the matching procedure, I can compare nearly identical municipalities. By using the data from the final matched sample I proceed with the estimation, as suggested by (Ho et al., 2007), from which I am able to estimate the causal effect of the political and economic factors on the adoption of the DtD model. Below I expose the matching procedure and the followed estimation models.

II) Matching strategy

To address the selection concern I proceed with the Propensity Score Matching, which selects the control municipalities based on the "propensity score" (Rosenbaum and Rubin, 1985; Ho et al., 2007; Stuart and Rubin, 2007) (see details below). As aforementioned, the identification strategy is based on the fact that, after the matching, I obtain from the original sample of 947 municipalities, a smaller sample with comparable municipalities, being this a balanced sample. In sum, I structured this methodology as a three steps procedure:

Step 1) I estimate a first Fixed Effects regression including only socio-demographic explanatory variables, in which the dependent variable is DtD. The explanatory variables are those social and demographic features that are expected to influence the adoption of the DtD model, according to the literature on recycling and management of waste. From this, I know which non-political characteristics influence the DtD model.

Step 2) I employ a Propensity Score Matching strategy where the control municipalities are selected through the "propensity score". The binary dummy variable DtD acts as a treatment. The matching is based on the covariates, which are the socio-demographic explanatory variables from the previous step. After the matching procedure, I obtain a smaller and homogeneous matched sample, m, comprising nearly identical municipalities.

Step 3) I specify a Fixed Effects model by using the new sample m, and the DtD as a dependent variable. From this, the coefficients of interest capture and estimate the causal effects of political and economic factors on the implementation of the DtD collection model.

Step 1) Fixed Effects specification. Firstly, I estimate a model where the dependent variable is the DtD. As explanatory variables, I include the socio-demographic variables, X'. I base the inclusion of these variables on previous literature and the theory on waste management and recycling waste. Hence, I include the population, the density, and the area of each municipality for the urban context of each municipality (Puig-Ventosa et al., 2013; Romano et al., 2019; ARC, 2021). Also, I include the age structure of the population, which is found to be a determinant for environmental issues and recycling performance (Soukiazis and Proença, 2020). Moreover, within a Spanish context, several studies (Ispos, 2019) and

Ecoembes (2019)[21] also report differences in attitudes and performances, between groups of ages, on recycling. In this study I structure the age population into three groups; from 0 to 14 years old, from 15 to 64 years old, and from 65 years old on, based on the data groups from *IDESCAT*. Furthermore, it is also stated that the education of the population is a factor that can be related to waste collection and recycling performance (Ipsos, 2019). Then, I include the levels of education distributed in five groups; Illiterates, No education, Primary education, Secondary Education, and High Education. Related to education level, I also include the share of foreigners. Finally, the number of green associations per capita is included as social capital. Time fixed effects, T, and municipality fixed effects, η, are included.

In this way, I identify the socio-demographic variables that are a common feature on the implementation of the DtD model. See Table A.2 in the Appendix.

Step 2) Propensity Score Matching. I proceed with the called Propensity Score Matching, first introduced by (Rosenbaum and Rubin, 1983). The "propensity score" is the probability that one observation i can be part of the Treatment, based on observed pre-treatment covariates (Ho et al., 2007). In this study, the DtD model acts as a Treatment, and the pre-treatment covariates are the socio-demographic variables. Therefore, within this matching strategy, the propensity score is calculated and used to match observations based on its "similar" propensity score (Stuart and Rubin, 2007).

I build a probabilistic model where the dependent variable is the binary dummy variable DtD, and the explanatory variables are the socio-demographic covariates, observed before the treatment.[22] The Treatment is the DtD observed in the year 2019 (end of the period). Contrary, C' is the set of municipal covariates observed in the year 2000 (pre-treatment). Aiming for a good balance of covariates and a good quality of the matching (Rosenbaum and Rubin, 1985; Ho et al., 2007; Stuart and Rubin, 2008), the municipal covariates are only included in the final Probit model when they are statistically significant. In this sense, the municipal covariates introduced in the probabilistic model are $log\ Population$, $Density$, $\%\ Non-Spanish$, and $\%Age2\ (15-64\ years\ old)$. See Table A.3 in the Appendix.

Following (Stuart and Rubin, 2008 and Ho et al., 2007) and considering the design of my study, I employ as a matching algorithm the 'nearest neighbor matching', which matches each treated observation to an untreated observation that has similar estimated propensity scores (Caliendo and Kopeinig, 2005; Stuart and Rubin, 2008). Moreover, I enable the variant 'with replacement' in which an untreated observation can be used more than once as a match. (Ho et al., 2007) By using so, I obtain a good quality of the matching while reducing the bias. I limit the matching for a single neighbor, which matches the closest control unit that has not yet been matched (Ho et al., 2007). Finally, I use a caliper of 0.05. I found this

[21] See details "*Las cifras del reciclaje*": [online] Available at: https://www.ecoembes.com/sites/default/files/cifras-reciclaje-2018.pdf

[22] Note the choice of the socio-demographic covariates is based on those variables from the previous step estimation, showing an influence on the adoption of the DtD model.

caliper as the one which provides me a good balance of the match. Figure A.5 in the Appendix illustrates the distribution of the propensity score before and after matching.

In the end, I obtain a matched sample, m, of 381 observations from which 212 are treated and 169 are untreated. The treated observations are all 212 municipalities that had implemented the DtD model in 2019, in my original panel. The 169 untreated observations are municipalities without the DtD model. The 381 observations from the matching sample are nearly identical municipalities, only differing on the adoption of the DtD collection model. I check for the balance of the match by comparing, before and after the match, at several indicators; differences in means, the reduction bias, the pseudo R2, and the joint test (Rosenbaum and Rubin, 1983; Caliendo and Kopeinig, 2005; Ho et al., 2007).

Once I conclude the good quality of the match, I proceed with the analysis. Note in section 7 is discussed the matching procedure.

Step 3) Fixed Effects specification after matching. I build the final panel using the matched sample, and I estimate the following model (2):

$$DtD_{it} = \gamma_1 PoliticalFactors_{it} + \gamma_2 Landfilltax_{it} + \vartheta C'_{it} + \Omega X'_{it} + \mu P'_{it} + \eta_i + T_t + \varepsilon_{it} \qquad (2)$$

where i is a Catalan municipality from the matched sample in year t. The $Political\ Factors$ refers to the variables on female representation and the "green" parties' representation in the municipal council. On the other hand, the $Landfill\ tax$ is the economic factor derived from the Catalan tax on landfill disposal. Moreover, there are included socio-demographic and political control variables, C', X', P'. Time fixed effects, T, and municipality fixed effects, η, are included. Time fixed effects control for unit-specific effects due to time, then capture varies over time but is common to all municipalities. Municipality fixed effects capture time-invariant municipality characteristics. Additionally, in the model (2) I use weights as suggested by (Ho et al., 2007). The use of weights considers how many observations each observation represents, thus, ensuring the actual observations after the matching (Ho et al., 2007).

There are included as control variables; the socio-demographic covariates used in the Probit model for the construction of the match, C', as the logarithm of the population, the density, the share of foreigners, and the group age (15-64 years old). Also, there are included the left socio-demographic control variables were discarded from the match, X', as suggested by (Ho et al., 2007). The set of political control variables, P', includes controls for the majority of seats, the re-election of the mayor, and the ideology of the municipal council in terms of the share of left-wing seats.

Coefficients of interest. From model (2), the coefficient γ_1 captures the causal effect between political factors, as female representation; $Female\ Mayor$ and $Share\ of\ Female\ Seats$, and the "green" parties' representation; $Green\ Mayor$ and $Share\ of\ Green\ Seats$, on the adoption of the DtD model. On the other

hand, γ_2 captures the causal effect of the Catalan tax on landfill disposal, $Landfill\ tax,$ on the adoption of the DtD model.

7 Results

This section shows the main results from the study and presents a robustness analysis. I also discuss the matching procedure and the quality of the match.

7.1 Main results

I) Baseline Model. Results

The results from the model (1) are shown in Table 2, from which I analyze the main determinants that influence the recycling rate of municipal waste. Table 2 presents three columns, all of them estimated with a Fixed Effects panel estimator. Column 1 includes the socio-demographic variables. Column 2 adds, into the previous variables, the political controls variables. And Column 3 also adds the dummy variable of the DtD collection model.

Results from Table 2 clearly suggest the DtD collection model is the main determinant of the recycling rate, being its effect positive and statistically significant (at the 1% level). Moreover, the logarithm of the population and the density shows a negative and statistical significance effect (at 1% level) on the recycling rate, in all three models. These two demographic factors were expected to be negative, as also reported in previous studies (Puig-Ventosa et al., 2013; ARC, 2021). The share of foreigners and the levels of education show positive and statistically significant effects, in all three models. In this sense, there are not notorious differences among levels of education, even though the group with higher education is the one which seems to influence the most. Considering the age structure of the population, it is found the group between 15-64 years old is the only one showing a statistical significance effect, being this negative. Finally, it can be observed the green associations' per capita show a negative and statistically effect, which was not expected to have this negative sign.

The main conclusion from Table 2 is that the DtD collection model is found as the key determinant of the recycling rate of municipal waste in Catalonia. Given the importance of the DtD model for the recycling rate, the DtD becomes the outcome of interest from now on. Therefore, I continue the empirical analysis by employing the matching procedure. I aim to study the potential causal effect of political and economic factors on the adoption of the DtD collection model.

Table 2: Determinants of the recycling rate: the role of socio-demographic and political characteristics

	1	2	3
Area	0.3629	0.3142	0.1398
	(0.5932)	(0.5942)	(0.5358)
Density	-0.0088***	-0.0086***	-0.0064***
	(0.0012)	(0.0012)	(0.0011)
Log Population	-4.2487***	-4.1518***	-3.0536***
	(0.8671)	(0.8710)	(0.7856)
% Non-Spanish	0.1038**	0.1050**	0.0935**
	(0.0347)	(0.0347)	(0.0313)
% No Education	0.3914**	0.4006**	0.4520***
	(0.1489)	(0.1490)	(0.1343)
% Primary Education	0.3147*	0.3248*	0.3680**
	(0.1470)	(0.1471)	(0.1327)
% Secondary Education	0.3707*	0.3814**	0.4013**
	(0.1451)	(0.1452)	(0.1309)
% Higher Education	0.4186**	0.4264**	0.5061***
	(0.1473)	(0.1474)	(0.1329)
% Age1 (0-14 years old)	0.0082	0.0005	-0.0087
	(0.0734)	(0.0735)	(0.0663)
% Age2 (15-64 years old)	-0.2163***	-0.2285***	-0.2967***
	(0.0563)	(0.0566)	(0.0510)
Green Associations	-0.6108**	-0.6126**	-0.5068**
	(0.2029)	(0.2030)	(0.1830)
% Left Seats		0.0066	0.0110*
		(0.0050)	(0.0045)
Mayor Re-election		-0.8375	-0.5830
		(0.4884)	(0.4404)
Majority Seats		0.3019	0.3262
		(0.2622)	(0.2364)
DtD			24.8739***
			(0.4447)
Time Fixed Effects	Yes	Yes	Yes
Observations	14580	14580	14580

*Notes: Variable dependent: Recycling Rate (%). Standard errors in parenthesis. Significance levels: * for p<.05, ** for p<.01, and *** for p<.001.*

II) Propensity Score Matching

Balance and quality of the match. As exposed in section 5, the matching strategy selects observations from my original sample, based on a treatment variable and pre-treatment covariates. Then, this methodology aims to correct the selection concern from my original sample.

Within the matching framework, the DtD acts as a treatment. Consequently, the matched sample is divided into two subgroups; the treatment and the control groups. Note, in the original sample there are 212 municipalities with the DtD model and 735 municipalities without the DtD model. After the matching, I obtained a sample with 212 treated observations (with the DtD model) and 169 untreated observations (without the DtD model). Therefore, I check whether the matched sample is obtained with a good balance and good quality of the match based on (Rosenbaum and Rubin, 1985; Ho et al., 2007; Stuart and Rubin, 2007). Table A.3 in the Appendix shows the probabilistic model used for the matching and the estimated coefficients. The explanatory variables are only included in this Probit model if they are statistically significant (Caliendo and Kopeining, 2005; Ho et al, 2007). Remember these variables come from Step 1), where I analyze the non-political factors that determine the DtD model (see section 6). Table A.4 in the Appendix shows the main indicators for the evaluation of the balance. I compare, between treatment and

control group, the mean of the variables included in the match; the best the smallest the differences in means (Ho et al., 2007). Additionally, I look at the reduction bias of the variables included (Rosenbaum and Rubin, 1985). In my case, these are: $log\ Poulation$ 92.7%, $Density$ 73.4%, $\%Non-Spanish$ 94.9% and $\%Age2\ (15-64\ years\ old)$ 92.3%. On the other hand, I also check the t-Test between the treated and untreated groups (Rosenbaum and Rubin, 1985; Caliendo and Kopeining, 2005). These, after matching, are expected to be not significant. In my case, the p-values for the t-Test are: $log\ Poulation$ 0.924, $Density$ 0.571, $\%Non-Spanish$ 0.840 and $\%Age2\ (15-64\ years\ old)$ 0.894. Finally, I check the joint significance and the pseudo R^2 (Rosenbaum and Rubin, 1985; Caliendo and Kopeining, 2005). The joint significance test should be rejected after the matching, and not before the matching; p-values of the LR test are 0.000 before matching and 0.976 after the matching. Regarding the pseudo R^2, after matching this should be low, since no differences in the distribution of variables among the two groups are expected (Caliendo and Kopeining, 2005), in my case, this is 0.001.

Figure A.5 in the Appendix shows the distribution of the propensity score, before and after the matching. Notice, I obtained a sample of 381 remaining observations after the matching. Considering all the above I conclude for the good balance and quality of the matching procedure.

Estimation after matching. After the matching procedure, I proceed to estimate the Fixed Effects model (2), using the matched sample, m. Note, I do not use the propensity score procedure as a methodology of estimating a causal effect, through the treatment effect. Rather, I use the matching strategy for the selection of the sample previous to the estimation of the final model, as recommended by (Ho et al., 2007). The goal of the matching strategy is to obtain a balanced sample, with nearly identical municipalities. Therefore, I continue with the analysis by the Fixed Effects estimator, in which the final estimations also use weights, as required by (Ho et al., 2007). From this, I am able to capture the causal effect estimation.

III) Main results

In this subsection are shown the results of the causal effect estimation of the political factors, female representation and "green" parties' representation, and of the economic factor, the landfill tax, on the DtD collection model.

Female representation in the municipal councils: Table 3.1 and Table 3.2 report the results of the presence of female politicians' effect on the DtD model. All columns are Fixed Effects models, using the matched sample and weights. Firstly, in Table 3.1 it is shown the effect of female mayors on the adoption of the DtD model. This effect is negative and statistically significant, only, in Columns 1, 2, and 3. However, when finally including all socio-demographic controls into the model, Column 4, there is no statistically significant effect of female mayors on the adoption of the Dtd model. Secondly, Table 3.2 adds the impact of the share of female seats and the interaction between the two variables, on the DtD model. In the same

line, when controlling for political and socio-demographic variables, it is not found an influence of the share of female seats on the adoption of the DtD collection model. Neither of the interactions between the two variables on the DtD model. Notice I study the presence of female mayors, the share of female seats, and the interaction of both in a consecutive way.

Overall, results from Table 3.1 and Table 3.2 show no empirical evidence of the effect of female representation in the municipal council on the DtD model. Hence, the political factor of the gender of the politician does not show a statistically significant influence on the adoption of the DtD model.

Table 3.1: Effect of Female Mayor on the implementation of the Door-to-Door collection model

	1	2	3	4
Female Mayor	-0.0327**	-0.0260*	-0.0233*	-0.0110
	(0.0104)	(0.0107)	(0.0107)	(0.0125)
Demographic controls (not included in the matching)	No	No	No	Yes
Demographic controls (included in the matching)	No	No	Yes	Yes
Political controls	No	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Treated	212	212	212	212
Control	169	169	169	169
Observations	6696	6696	6696	6696

*Notes: Variable dependent: Door-to-Door dummy variable. The estimations use weights. "Treated" refers to the observations from the treatment group of the matched sample. "Control" refers to the observations from the control group of the matched sample. Standard errors in parenthesis. Significance levels: * for p<.05, ** for p<.01, and *** for p<.001.*

Table 3.2: Effect of Female Mayor and Female Seats on the implementation of the Door-to-Door collection model

	1	2	3	4	5	6	7	8
Female Mayor	-0.0360***	-0.0297**	-0.0270*	-0.0132	-0.0153	-0.0188	-0.0172	-0.0152
	(0.0106)	(0.0109)	(0.0110)	(0.0126)	(0.0234)	(0.0234)	(0.0234)	(0.0299)
Share of Female Seats	0.0003	0.0003	0.0003	0.0003	0.0004	0.0004	0.0004	0.0003
	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0003)
Female Mayor × Share of Female Seats					-0.0005	-0.0003	-0.0003	0.0001
					(0.0005)	(0.0005)	(0.0005)	(0.0007)
Demographic controls (not included in the matching)	No	No	No	Yes	No	No	No	Yes
Demographic controls (included in the matching)	No	No	Yes	Yes	No	No	Yes	Yes
Political controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Treated	212	212	212	212	212	212	212	212
Control	169	169	169	169	169	169	169	169
Observations	6696	6696	6696	6696	6696	6696	6696	6696

*Notes: Variable dependent: Door-to-Door dummy variable. The estimations use weights. "Treated" refers to the observations from the treatment group of the matched sample. "Control" refers to the observations from the control group of the matched sample. Standard errors in parenthesis. Significance levels: * for p<.05, ** for p<.01, and *** for p<.001.*

"Green" political parties: Table 4.1 and Table 4.2 present the results for the political effect of the "green" parties in the municipal council on the DtD collection model. All columns are Fixed Effects models, using the matched sample and weights. Firstly, Table 4.1 shows the results on the effect of "green" mayors on the adoption of the DtD model. There is not a statistically significant effect of the "green" mayors. Furthermore,

Table 4.2 adds the effect of the share of "green" seats and the interaction between the two variables on the DtD model. Results from Table 4.2 does not show a statistically significant influence on the adoption of the DtD model when adding all political and socio-demographic control variables. Moreover, the interaction of "green" variables does not show a statistical effect either. I study the effect of these variables consecutively.

In sum, Table 4.1 and Table 4.2 do not show empirical evidence of the political influence from the "green" political parties on the DtD collection model. Altogether, the above results indicate that no political factors appear to affect the adoption of the DtD collection model. Neither the presence of women in politics nor the influence of "green" political parties.

Table 4.1: Effect of Green Mayor on the implementation of the Door-to-Door collection model

	1	2	3	4
Green Mayor	-0.0131	-0.0055	-0.0041	0.0002
	(0.0088)	(0.0094)	(0.0094)	(0.0102)
Demographic controls (not included in the matching)	No	No	No	Yes
Demographic controls (included in the matching)	No	No	Yes	Yes
Political controls	No	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Treated	212	212	212	212
Control	169	169	169	169
Observations	6696	6696	6696	6696

*Notes: Variable dependent: Door-to-Door dummy variable. The estimations use weights. "Treated" refers to the observations from the treatment group of the matched sample. "Control" refers to the observations from the control group of the matched sample. Standard errors in parenthesis. Significance levels: * for p<.05, ** for p<.01, and *** for p<.001.*

Table 4.2: Effect of Green Mayor and Green Seats on the implementation of the Door-to-Door collection model

	1	2	3	4	5	6	7	8
Green Mayor	-0.0109	-0.0168	-0.0157	-0.0059	0.0308	0.0095	0.0100	0.0102
	(0.0100)	(0.0100)	(0.0100)	(0.0110)	(0.0196)	(0.0203)	(0.0203)	(0.0227)
Share of Green Seats	-0.0001	0.0007**	0.0008**	0.0004	0.0002	0.0009***	0.0009***	0.0005
	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0003)
Green Mayor × Share of Green Seats	-	-	-	-	-0.0009*	-0.0006	-0.0006	-0.0004
					(0.0004)	(0.0004)	(0.0004)	(0.0005)
Demographic controls (not included in the matching)	No	No	No	Yes	No	No	No	Yes
Demographic controls (included in the matching)	No	No	Yes	Yes	No	No	Yes	Yes
Political controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Treated	212	212	212	212	212	212	212	212
Control	169	169	169	169	169	169	169	169
Observations	6696	6696	6696	6696	6696	6696	6696	6696

*Notes: Variable dependent: Door-to-Door dummy variable. The estimations use weights. "Treated" refers to the observations from the treatment group of the matched sample. "Control" refers to the observations from the control group of the matched sample. Standard errors in parenthesis. Significance levels: * for p<.05, ** for p<.01, and *** for p<.001.*

Landfill tax: I continue by studying the effect of the economic factor on the DtD collection model. Table 5 reports the results of the landfill tax's effect on the DtD model. All five columns are Fixed Effects models, using the matched sample and weights. From Table 5 it is observed this economic instrument has a positive and statistically significant effect (at 1% level) on the DtD collection model. This result is statistically significant also when including all socio-demographic and political controls variables, Column 5. This coefficient estimates the causal effect of the landfill tax on the DtD collection model, and it is estimated that one unit more of the Landfill Tax (€/t) increases the probability to adopt the DtD collection model in 1.37 percentage points.

Therefore, in accordance with the main results the economic motive, as the landfill tax, is the only factor found that influences the adoption of the DtD collection model. Conversely, no political factors are behind the DtD model.

Table 5: Effect of Landfill tax on the implementation of the Door-to-Door collection model

	1	2	3	4	5
Landfill Tax	0.011855***	0.012071***	0.010796***	0.009445***	0.013727***
	(0.0002)	(0.0003)	(0.0003)	(0.0004)	(0.0010)
Demographic controls (not included in the matching)	No	No	No	Yes	Yes
Demographic controls (included in the matching)	No	No	Yes	Yes	Yes
Political controls	No	Yes	Yes	Yes	Yes
Term of Office time Effects	No	No	No	No	Yes
Treated	212	212	212	212	212
Control	169	169	169	169	169
Observations	6696	6696	6696	6696	6696

*Notes: Variable dependent: Door-to-Door dummy variable. The estimations use weights. "Treated" refers to the observations from the treatment group of the matched sample. "Control" refers to the observations from the control group of the matched sample. Standard errors in parenthesis. Significance levels: * for p<.05, ** for p<.01, and *** for p<.001.*

7.2 Robustness analysis

This study attempts to analyze the effect of two political factors and one economic factor on the adoption of the DtD collection model. Conversely, the robustness check analyses the main results in a different sense. I consider the possibility that political and economic factors could influence the DtD model at the same time. Hence, I check whether both political factors, such as female representation and the "green" parties' representation, together with the economic factor, the landfill tax, affect the DtD model in the same way as the main results whereas they are considered at the same time.

I construct Table 6, where the three columns. Column 1 shows the results considering only the effect of female representation in local politics. Column 2 adds to the previous variables the effects of the presence of "green" political parties. Hence, Column 2 shows the effect of all political factors considered in the analysis, together. Finally, Column 3 includes the effect of the landfill tax on the above effects.

From Table 6 it is observed the results from the robustness analysis are in the same line as the main results of this study. Firstly, there is no statistically significant effect of the presence of women in politics on the DtD model. Moreover, there is no statistically significant effect of the "green" parties either. Hence,

no political factors seem to affect the DtD model. Contrary, there is a positive and statistically significant effect (at 1% level) of the economic factor on the DtD model, this coefficient estimates the causal effect of the landfill tax on the adoption of the DtD model. Also, when considering all political factors. Therefore, the landfill tax is the only factor that proves empirical evidence of a positive effect on the adoption of the DtD model. Hence, I verify that when considering all political and economic factors at the same time, the main results remain.

Table 6: Robustness analysis

	1	2	3
Female Mayor	-0.015186	-0.007976	-0.007976
	(0.0299)	(0.0303)	(0.0303)
Share of Female Seats	0.000316	0.000340	0.000340
	(0.0003)	(0.0003)	(0.0003)
Female Mayor × Share of Female Seats	0.000054	-0.000214	-0.000214
	(0.0007)	(0.0008)	(0.0008)
Green Mayor		0.009627	0.009627
		(0.0228)	(0.0228)
Share of Green Seats		0.000503	0.000503
		(0.0003)	(0.0003)
Green Mayor × Share of Green Seats		-0.000365	-0.000365
		(0.0005)	(0.0005)
Landfill Tax			0.013805***
			(0.0011)
Demographic controls (not included in the matching)	Yes	Yes	Yes
Demographic controls (included in the matching)	Yes	Yes	Yes
Political controls	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Treated	212	212	212
Control	169	169	169
Observations	6696	6696	6696

*Notes: Variable dependent: Door-to-Door dummy variable. The estimations use weights. "Treated" refers to the observations from the treatment group of the matched sample. "Control" refers to the observations from the control group of the matched sample. Standard errors in parenthesis. Significance levels: * for p<.05, ** for p<.01, and *** for p<.001.*

8 Conclusions

Climate change is one of the biggest challenges the world faces nowadays. The multilateral political agreements, taking place at the international stage, emphasize the local action for this global problem, considering the waste management sector as very strategic. This study understands the relevance of local politicians in the fight against climate change; I aim to analyze the political and economic factors that influence the adoption of the DtD collection model. The management of municipal waste and selective waste collection has become essential political decisions to achieve high rates of recycled waste.

The main results of this study do not find empirical evidence that female representation affects the adoption of the DtD model. Moreover, I do not find that "green" political parties influence, either, the adoption of the DtD model. In sum, no political factors show statistically significant effects on the DtD model, suggesting there are no political motives behind the adoption of the DtD model in Catalan

municipalities. On the other hand, the main results find a positive influence of the landfill tax on the DtD model. This is a causal effect between the landfill tax and the adoption of the DtD, estimated as the one unit more of the landfill tax (€/t) increases the probability to adopt the DtD collection model by 1.37 percentage points. Therefore, the economic motive is the only factor that influences the adoption of the DtD model.

In the same direction as me, some economic literature reported no evidence of the role of female politicians on political outcomes (Ferreira and Gyourko, 2014; Bagues and Campa, 2018; Carozzi and Gago, 2021). However, in this study, it is found that no political factors are influencing the decision on the DtD model, neither form the representation of "green" parties. The economic factor is found to be the only motive behind the adoption of the DtD model, in the same line as reported in studies by ENT (2012) and APAP (2021).

The findings of this study have several policy implications. Firstly, it shows the landfill tax is an effective instrument to redirect the environmental policies to a more green and sustainable horizon, following the direction of the international agreements on climate action. Therefore, this economic instrument is found as efficient in its goal to increase the recycling rate of municipal waste, while incentivizing local politicians to commit to stricter environmental policies, such as the adoption of the DtD collection model. And so, to achieve high rates of recycling waste, promote selective waste collection, and reduce waste generation.

On the other hand, no political influence behind the DtD model. Neither from female representation in local politics nor the "green" local parties. This fact could be explained by the specific design of this collection model. The DtD model directly implies an important change of habits for the citizens that are subject to, influencing their daily routines on recycling domestic waste and waste collection. Then, it seems to be a challenge to adopt the DtD collection model when citizens disagree with such direct influence on them. In other words, local politicians have to decide to adopt this brave environmental policy despite the discontentment of some citizens. They need to be convinced with the adoption of the DtD model, regardless of the citizen's opinion or even regarding the further electoral results. Altogether, these features draw the complex context of the adoption of the DtD model at the municipal level, and help us to understand why this model is not vastly used across Catalonia, among other factors.

Finally, two remaining facts behind this master thesis, in my view, are relevant to mention. On the one hand, the limited commitment of political parties to environmental protection. It seems to be a pending subject that urgently needs to be considered given the current climate emergency. And, on the other hand, the vast under-representation of women in local politics, particularly when becoming a mayor. In twenty years, from 2000 to 2020, it achieved the share of 23% of female mayors in Catalan municipalities. This is far from full gender parity, and illustrates the huge structural problem societies face with women in public positions, particularly when becoming political leaders.

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Appendix

Table A.1: Summary statistics control variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Area	33.92847	34.92593	0.4	302.82
Density	427.4269	1554.982	0.7	21724.4
Log Population	7.066979	1.687539	2.944439	14.30823
% Non-Spanish	8.154029	6.754636	0	52.2489
% No Education	9.619275	6.4555	0	58.33333
% Illiterates	1.276297	1.23895	0	9.78399
% Primary Education	27.01289	12.02213	0	85.29412
% Secondary Education	35.1762	9.335471	4.104478	74.81752
% Higher Education	26.91534	9.743142	1.845018	69.98301
% Age1 (0-14 years old)	13.47795	3.870594	0	24.95238
% Age2 (15-64 years old)	65.36302	4.561591	39.21569	92.59259
% Age3 (>65 years old)	21.15902	6.732075	5.263158	58.53658
Green Associations	1.01894	2.625983	0	35.71429
% Left Seats	41.2762	29.51918	0	100
Majority Seats	0.7265427	0.4457453	0	1
Mayor Re-election	0.0758184	0.2678867	0	1

Table A.2: Determinants of the DtD model: Socio-demographic characteristics

	1	2	3	4	5	6	7
Log Population	-0.042407***	-0.042444***	-0.034937**	-0.042011***	-0.041933***	-0.040431**	-0.043319**
	(0.0118)	(0.0118)	(0.0120)	(0.0121)	(0.0127)	(0.0149)	(0.0151)
Area		0.010977	0.008020	0.008908	0.008753	0.007934	0.007970
		(0.0110)	(0.0110)	(0.0110)	(0.0110)	(0.0103)	(0.0103)
Density			-0.000074***	-0.000080***	-0.000072***	-0.000083***	-0.000084***
			(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
% Non-Spanish				0.002386***	0.002093***	0.000549	0.000538
				(0.0005)	(0.0005)	(0.0006)	(0.0006)
% Age1(0-14 years old)					0.000883	0.000281	0.000276
					(0.0009)	(0.0013)	(0.0013)
% Age2 (15-64 years old)					0.001961**	0.002571**	0.002586**
					(0.0007)	(0.0010)	(0.0010)
% Age3 (>65 years old)					0.000000	0.000000	0.000000
					(.)	(.)	(.)
% No education						0.001127	0.001123
						(0.0008)	(0.0008)
% Illiterates						0.003102	0.003086
						(0.0026)	(0.0026)
% Primary Education						0.001464*	0.001466*
						(0.0007)	(0.0007)
% Secondary Education						0.002408***	0.002406***
						(0.0007)	(0.0007)
% Higher Education						0.000000	0.000000
						(.)	(.)
Green Associations							-0.004029
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14580	14580	14580	14580	14580	14580	14580

*Notes: Variable dependent: Door-to-Door model. Standard errors in parenthesis. Significance levels: * for p<.05, ** for p<.01, and *** for p<.001.*

Table A.3: Probabilistic Model

Door to Door	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Log Population	.1739914	.0398733	4.36	0.000	.0958412	.2521416
Density	-.0001417	.0000493	-2.87	0.004	-.0002384	-.000045
Non Spanish	-.0797498	.020738	-3.85	0.000	-.1203955	-.0391042
% Age (15-64)	-.0302609	.0102647	-2.95	0.003	-.0503794	-.0101424
Cons	.2575736	.6072592	0.42	0.671	-.9326324	144.778

Notes: Estimation: Probabilistic regression. Variable dependent: Door-to-Door model. Standard errors in parenthesis.

Table A.4: Test of the balance of the matching

Variable	Unmatched / Matched	Mean		% bias	% reduct |bias|	t-test	
		Treated	Control			t	$p > \|t\|$
Log Population	U	7.0307	6.8438	12.3	92.7	1.48	0.139
	M	7.0307	7.0445	-0.9		-0.10	0.924
Density	U	292.21	503.93	-14.3	73.4	-1.68	0.094
	M	292.21	348.58	-3.8		-0.57	0.571
% Non-Spanish	U	2.0632	2.8547	-30.4	94.9	-3.63	0.000
	M	2.0632	2.0229	1.5		0.20	0.840
% Age2 (15-64 years old)	U	64.67	65.54	-17.3	92.3	-2.14	0.033
	M	64.67	64.603	1.3		0.13	0.894

Sample	Pseudo R^2	LR chi2	$p > chi2$
Unmatched	0.040	40.02	0.000
Matched	0.001	0.47	0.976

Figure A.5: Distribution of Propensity scores