Psychosocial and economic impacts of a charge in lightweight plastic carrier bags in Portugal: Keep calm and carry on?

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Abstract

Reducing plastic waste has become an urgent global challenge. To help fight this problem, European countries have undertaken the mission to reduce lightweight plastic bag consumption. In 2014, Portugal implemented a charge on lightweight plastic bags, calling for an adjustment from both consumers and firms. The present research aims to study the psychosocial and economic impacts of this tax measure, namely in terms of acceptability of the measure, potential attitude and behaviour changes, and impact on plastic bag markets. The psychosocial impacts were studied based on an online survey ($N = 198$) and on available datasets illustrating societal trends. Survey results showed that participants agreed with the charge and with widening it to all types of plastic bags. They attributed environmental motives to its implementation, developed reuse habits and mentioned a decreased consumption of disposable plastics. In addition, individuals appear more concerned with the impacts of everyday plastic products in the environment, and more willing to pay higher taxes and prices to protect the environment. The economic impacts were studied using available data on the charge revenue and on the production and sales of plastic bags, among others. We illustrate that the implementation of the charge led to a sharp fall in the use of lightweight bags, generating a decrease in the production and sale of plastic bags overall, while avoiding significant impacts on the relevant economic sectors.

Keywords: charge; lightweight plastic bag; psychosocial impacts; economic impacts.

Psychosocial and economic impacts of a charge in single-use plastic carrier bags in Portugal: Keep calm and carry on?

1. Introduction

Since it was introduced in the 1950s, plastic quickly became the most produced material, present in all areas of everyday life (Al-Salem et al., 2009). As highlighted by the World Economic Forum (2016), if the growth in plastic production continues at the current rate, by 2050 the plastic industry will account for 20% of the world's total oil consumption. Furthermore, existing waste management strategies are insufficient to reduce the environmental impact of plastic waste. Estimates indicate that 79% of the plastic waste ever produced now sits in landfills, dumps or in the environment, about 12% has been incinerated and only 9% has been recycled (Geyer et al., 2017).

Reducing the production and consumption of plastic has become a global challenge, especially for single-use items. In this context, a popular starting point for societal responses was to take on plastic bags, in particular lightweight or carrier plastic bags. The consumption of lightweight plastic bags (with a thickness less than or equal to 50 microns) is tremendous. In the European Union (EU) almost 100 billion plastic bags are consumed per year, which translates into an average individual consumption of 200 plastic bags. Almost all of these bags (89%) were used only once before they became waste. This undue consumption of bags has detrimental consequences for the environment. Since the recycling rate is very low (approximately 6.6%), about half of the bags were sent to landfills, from where they can be carried by the wind and dispersed into the environment. Such waste can last hundreds of years, albeit becoming fragmented overtime. Plastic bags, along with other plastic items, make up 80% of the waste accumulated in the ocean, with serious negative impact on marine ecosystems (European Commission, 2017). The costs of marine

litter are also evident for fisheries and tourism (Newman et al., 2015), while potential damages to human health cannot be excluded.

Efforts to reduce the consumption of lightweight plastic bags is therefore a worthwhile undertaking, with community support (e.g., Macintosh et al., 2020). Accordingly, several European countries have applied policies such as charges, and even bans, on lightweight plastic carrier bags, while the EU specifically targeted these items in Directive 2015/720/EU. Denmark become, in 1994, the first country to place a charge on plastic bags. The country applied an upstream tax at the import or manufacturing level. The economic burden of the tax was then passed along to consumers who must pay for bags at the stores. This led to a 60% reduction on the amount of plastic bags (GHK, 2007). Ireland was the first country to introduce a plastic-bag levy to consumers, in 2002, also with dramatic results (Convery et al., 2007). Many EU countries followed suit, applying different policies to reduce the consumption of plastic bags (e.g., Luxembourg and Belgium in 2007, Malta, Spain and Romania in 2009). Some applications have also been pursued outside the EU (e.g., O'Brien and Thondhlana, 2019). In Portugal, a charge[1] on lightweight plastic carrier bags was part of the Green Tax Reform, approved in December 2014 and implemented in February 2015 (Law 82-D/2014). This legislation requires producers and importers to pay, and charge end-users, a monetary contribution of € 0.08, plus VAT (23%), that is, a total of € 0.1 for each lightweight plastic bag. Furthermore, economic operators are called upon to promote complementary measures, namely: (a) to raise awareness and to encourage consumers to seek alternatives, while aiming to reuse lightweight plastic bags; (b) to promote practices of selective disposal for recycling of the plastic bags that cannot be reused; (c) to provide reusable means to transport groceries at affordable prices to consumers. The charge revenues are partly directed

[1] "Contribuição sobre os sacos de plástico leves", Chp. V, Law 82-D/2014.

92 towards the general government budget (75%) with the remainder earmarked for various purposes
93 (environmental fund, environmental agency, tax authority and inspection services).

94 Following the implementation of the Portuguese Green Tax Reform, both consumers and
95 economic operators ought to have adjusted to the charge, allowing its psychosocial and economic
96 impacts to be measured.

97 In the psychosocial field, several studies have looked at the impact of lightweight plastic
98 bag charges on consumer practices and perceptions. Indeed, evidence has shown that although
99 plastic bags are convenient, available and affordable, more environmental-friendly alternatives are
100 being chosen, especially by people with certain sociodemographic features (e.g., more years of
101 education, urban population (O'Brien and Thondhlana, 2019; Zambrano-Monserrate and
102 Alejandra Ruano, 2020). In Portugal, data from a survey of 1500 people (Schmidt et al., 2016)
103 indicates that the Portuguese mostly considered this a successful measure, since it contributed to
104 the decrease of plastic waste, created an obligation to buy proper garbage bags (many consumers
105 formerly reused lightweight bags for their garbage) and encouraged the reuse of bags to carry
106 groceries. However, results also indicated that people with greater adherence to ecological values
107 were the ones who evaluated the measure as most positive. Regarding the influence of the charge
108 on other practical aspects of their daily lives, 17.8% stated that they increased waste separation
109 while 11.3% reduced waste separation because free lightweight bags were no longer available.
110 These results suggest that the charge may have had both positive and negative spillover effects on
111 recycling. Other studies provide more optimistic results. In England, the plastic bag charge
112 changed behaviour and appears to have increased support for other charges to reduce plastic waste
113 (Thomas et al., 2019).

Previous studies suggest that the different effects of the charge might be related to different motivations. In particular, the distinction between financial motivations and environmental motivations matters. Financial motivations are an extrinsic type of motivation, because behavioural changes only happen if the charge is significant, as long as it is maintained. Environmental motivations are an intrinsic type of motivation, and behavioural change hinges less on charge values because individuals internalise the relevance of the environmental issue. Naturally, individuals accept the charge more willingly when they believe the latter (Jakovcevic et al., 2014). People's motivations must therefore be understood to enhance the positive impacts of lightweight bag charges (Poortinga et al., 2013; Thomas et al., 2016), so charge presentation is of remarkable importance. Another study conducted with a Portuguese sample (Martinho et al., 2017) illustrated that most individuals assumed policy makers implemented the charge for financial purposes, rather than to reduce the consumption of bags. These results are strikingly negative, considering individuals also tend to support charges even more if the policy goal is to benefit the environment, rather than if the perceived focus is on revenue raising (Jakovcevic et al., 2014). Such societal perceptions might undermine additional future measures to reduce plastic waste.

As far as economic aspects are concerned, direct and indirect impacts can be expected. The charge directly affects the consumption of lightweight plastic bags, which according to data from the Tax Authority (Autoridade Tributária - AT) decreased markedly, but there might also have been indirect impacts brought on by behavioural change. Examples would be bag reuse in grocery shopping or a switch to other types of plastic bags, which became available in all commercial surfaces after the reform. Additionally, an increase in the consumption of garbage bags could be

expected: for example, Martinho and colleagues (2017) noted a 12% increase in the consumption of garbage bags in a cross-sectional sample of 418 individuals.

This study appraises the psychosocial and economic impacts of the Portuguese lightweight plastic bag levy. For the first type of impacts, the focus is on: a) evaluating consumer perceptions of the charge and its impact on behaviour, as well as the acceptance of additional policy measures to reduce plastic waste and b) exploring possible spillover effects. We further analysed societal evolution on environmental perceptions using survey questions before and after the charge was introduced. The economic impacts are seen through the evolution of lightweight plastic bag consumption, the revenues generated by the charge and the potential switch to alternative bags. In the remainder of the paper we present the impact assessment methodology (section 2), the main results (section 3) and then a discussion of the impacts (section 4). The final section (section 5) presents a brief summary of the conclusions.

2. Method

2.1. Psychosocial impacts

2.1.1. Participants

Our survey included a questionnaire that combined the issues raised in the literature with the results of 12 face-to-face structured interviews to consumers, carried out in commercial establishments in the metropolitan area of the city of Lisbon during the month of November 2017. Six establishments were selected, varying in size (small, medium and large) and type of supply (economic products, organic products, mixed).

For the online survey, we recruited a disproportionate stratified sample of participants with equivalent quotas for geographical regions, age group and schooling using the service Qualtrics Panels. A total of 198 responses were collected. Participant age ranged between 18 and 89 years

old (*M*=40.6, *SD*=16.9), they were mostly males (67.7%), and had different educational levels: elementary school (24%), high school (37%) and higher education (39%). Participant distribution by Portuguese regions (NUTS II) was as follows: North 21.1%, Centre 21.7%, Lisbon region 23.7%, Alentejo 17.7%, Algarve 15.7%.

2.1.2. Measures

For the structured interviews, the participants were asked: 1) how they usually carried their purchases (for weekly/monthly and occasional purchases); 2) if there was a change on the chosen carrying method for the groceries; 3) whether they reuse the bags; 4) in case of change, why did it happen. Finally, concerning the charge, participants' opinion on having to pay for the bags at the supermarket was asked; whether they believe that people still pay the light bags fee; whether it was important for the environment, and why; whether this measure led to other changes (e.g., waste separation, adopting a more sustainable lifestyle).

The analysis of the preliminary interviews illustrated the importance of exploring several aspects, namely: people's knowledge about the charge, its motivation and effects; possible spillovers of the charge to other behaviours (e.g., storage of garbage, adoption of a more sustainable lifestyle); and habits of plastic bag reuse and purchase. Thus, the survey was designed to evaluate these variables as well as general societal trends on environmental issues. Variables were measured as described below, mostly following previous studies, not only to ensure validity but also to allow comparisons.

Knowledge about the charge. Individuals were asked which type of bags were covered by the charge (multiple responses allowed): a) *lightweight plastic bags (previously free of charge)*, b) *plastic bags with a thickness exceeding 50 µm (generally sold at the supermarket cashier)*, c) *raffia*

bags (generally sold at the supermarket cashier). Each option depicted an image of the relevant bag.

Policy maker grounds for introducing the charge (Martinho et al., 2017). Participants were asked to select the reason why policy makers introduced the charge, among the following options: a) *one more tax / get more money for the state,* b) *environment/reduction of the number of plastic bags/waste*, c) *increase reuse/recycling of plastic bags*, c) *save natural resources* ,d) *I do not know / no opinion*, e) *other reasons.*

Perceived effects of the charge (adapted from Schmidt et al., 2016). Participants were asked to what extent the charge on lightweight plastic bags had the following effects: a) *encouraged people to reuse bags for shopping*, b) *led people to buy garbage bags*, c) *decreased the volume of plastic waste*, d) *improved the environment*, e) *created profit for retailers*, f) *increased state revenues*, g) *increased household expenditures*, h) *increased public awareness of plastic waste* (scale ranging 1, *totally agree*, to 5, *totally disagree*).

Perceived spillover effects of the charge on individual waste management (adapted from Schmidt et al., 2016). Participants were asked to what extent they agreed with the following statements: *the payment of the charge* a) *increased the amount of waste I separate*, b) *reduced the amount of waste I separate because free lightweight plastic bags are no longer available,* c) *reduced my use of disposable plastics (e.g., plastic cups and plates) because I am more aware of the plastic waste problem*, d) *had no influence on my use of disposable plastics* (scale ranging 1, *totally agree*, to 5, *totally disagree*).

Grocery bag habits (adapted from Gardner et al., 2012). The reuse and purchase habits were assessed using four items: frequency, automaticity, awareness and spontaneity of the behaviours (scale ranging 1, *totally agree*, to 7, *totally disagree*). The items were averaged into

composite measures of the habits with adequate internal consistency (α = .76 for reusing, and α = .98 for buying).

Attitude towards charge changes. Participants were asked the extent to which they agreed with a) *the widening of the charge to all types of plastic bag, b) the ban on the sale of plastic bags with a thickness exceeding 50 µm*, c) *the ban on the sale of raffia-type plastic bags* (scale ranging 1, *totally agree*, to 5, *totally disagree*).

Risk perception of plastic products (Eurobarometer, 2017). Individual's worriedness on the environmental and health impacts of everyday plastic products (scale ranging 1, *totally agree*, to 4, *totally disagree*).

Environmental concern (ISSP Research Group, 2012). This includes three measures: individual willingness to pay i) higher taxes and ii) higher good prices, and iii) to accept cuts in living standards, in order to protect the environment (scale ranging 1, *totally agree*, to 5, *totally disagree*).

2.2. Economic Impacts

We employed statistical data on the trends in the number of lightweight plastic bags, on the revenue obtained by the AT, and on the quantities produced (manufacturers) and consumed (distribution companies) for the various categories of bags. Due to the lack of information provided by manufacturers and distributors, the collected data are incomplete, but some insights can still be gained. Data sources were: Statistics Portugal (INE), Portuguese Association of Plastics Industry, Portuguese Business Association as well as the main companies in this industry – Silvex and Alberplás. In addition, overall data on the manufacturers of plastic packaging (turnover, number of employees, net result) and packaging waste were compiled to provide context (Bank of

Portugal). Since the charge was only implemented in 2015 there are insufficient yearly observations to carry out an econometric analysis.

3. Results

We used nonproportionate quota sampling and, therefore, the sample was distorted toward the population. In order to have an adequate sample, we did a weighting adjustment. This is a common correction technique that balances the data in order to represent the population more accurately. Adjustment weights were calculated comparing the observed frequency distribution of the variables with the population's distribution and they were assigned to each survey respondent (Chambers and Skinner, 2003). The survey data was weighted for age range (15-29, 30-49, 50-64, 65-84), schooling (elementary school, high school, higher education) and sex, for each region of continental Portugal (NUTS II), according to data from Census 2011 (Instituto Nacional de Estatística, 2011). All analyses were performed with the weighted sample.

3.1 Psychosocial impacts

3.1.1. Specific impacts of the charge

Knowledge about the charge. Many individuals believed (incorrectly) that the charge covered plastic bags with a thickness exceeding 50 μm (46%). Indeed, this number is higher than those who correctly answered that the charge covered only lightweight plastic bags (40%). Notably, most retailers initially supplied lightweight bags to customers, highlighting that they were forced to charge the mandatory €0,10, until stocks ran out; then, lightweight bags were replaced by thicker bags, sold at the same price. Thus, consumers probably believe that they are still paying the charge when they are actually buying a grocery bag.

Policy maker grounds for introducing the charge (adapted from Martinho et al., 2017). Martinho and colleagues (2017) compared perceptions before and after the implementation of the

charge in 2015 and found an increase in the number of people that considered the charge was "*one more tax / more money for the state"* (45.9% to 60.6%) and a decrease in the number of people that considered the charge was implemented because of "*environment/reduction of number of plastic bags/waste"* (32.4% to 18.3%). The results of our survey in 2018 were closer to the ones right before the implementation of the charge (35.2% selected "*one more tax / more money for the state"*), but more people chose the environmental option (42.1% selected "*environment/reduction of number of plastic bags/waste"*). This suggests that the negative reaction that followed the implementation might have been temporary, possibly due to the immediate additional expense. The present trend is more encouraging, since, as noted above, people are more likely to support measures when they associate them with environmental rather than financial goals (Jakovcevic et al., 2014).

Perceived effects of the charge. Most participants agreed that the charge had all the effects we had anticipated; the most commonly selected options were: "*encouraged people to reuse bags for shopping", "increased state revenues", and* "*sensitized the public on the subject of plastic waste"* (Figure 1).

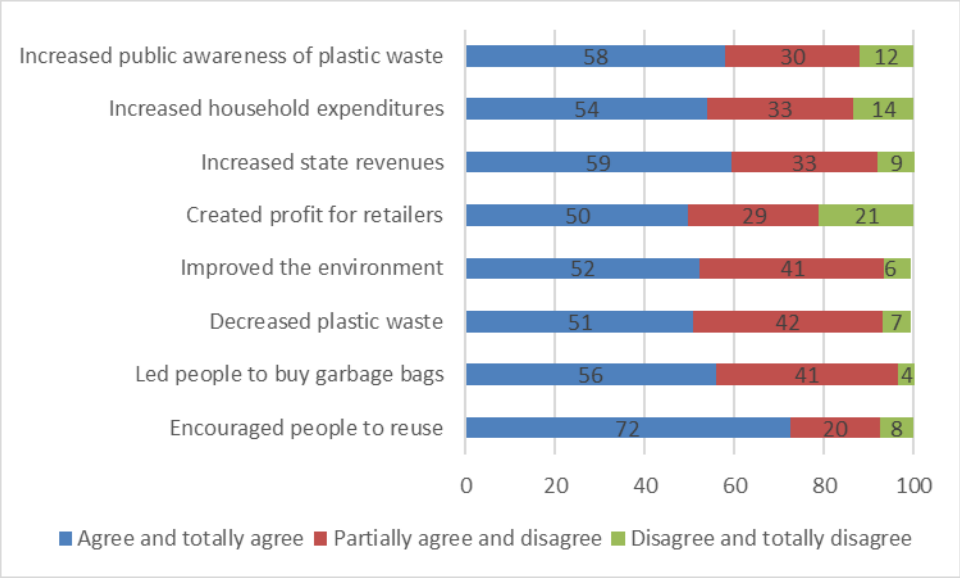

Figure 1. Perceived effects of the charge.

Perceived spillover effects of the charge on individual waste management. Most participants considered the charge had positive effects, namely: it diminished their personal use of disposable plastics (61%) and it increased their waste separation, even if they had to use other types of bags (41%). Still, a significant number of individuals reported that they reduced their waste separation (37%) (Figure 2).

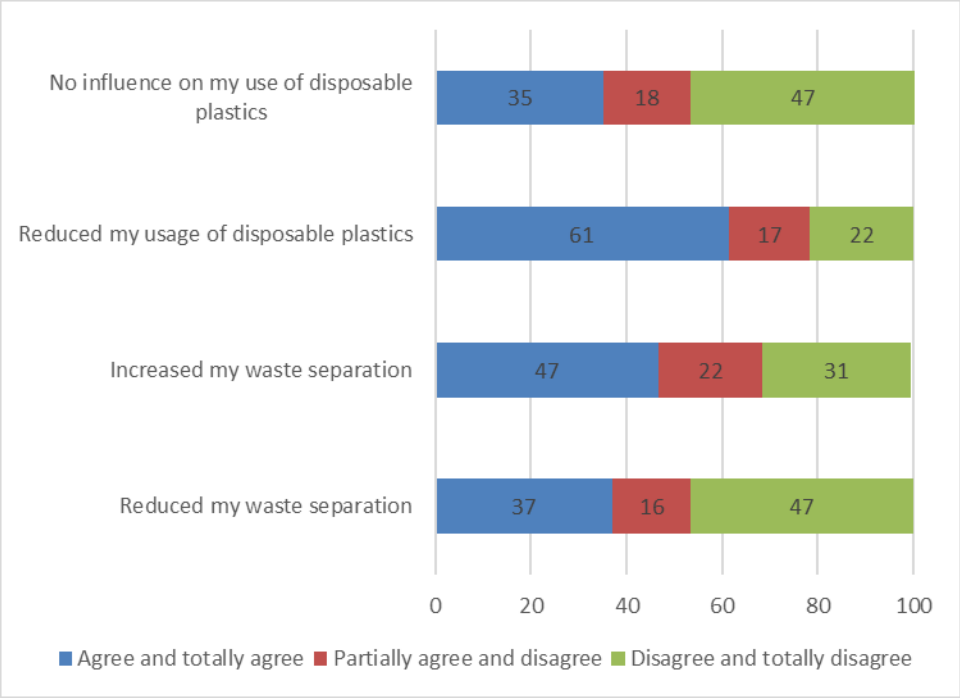

Figure 2. Perceived spillover effects of the charge on how individuals manage their waste.

Grocery bag habits. The habit of bag reuse was medium / high (*Mean* = 5.12, *Standard deviation* = 1.34) and it was higher that the habit of buying grocery bags (*Mean* = 3.32, *Standard deviation* = 2.10). These results suggest that the reuse habit is better established than the habit of

buying bags. Reusing has become a behaviour that people do more frequently, in an automatic and spontaneous manner, and without awareness.

Attitude towards charge changes. Most participants agreed with widening the charge to all types of plastic bags and banning raffia-type plastic bags, although many were undecided (Figure 3). The most popular measure was banning plastic bags with a thickness exceeding 50 µm (61%).

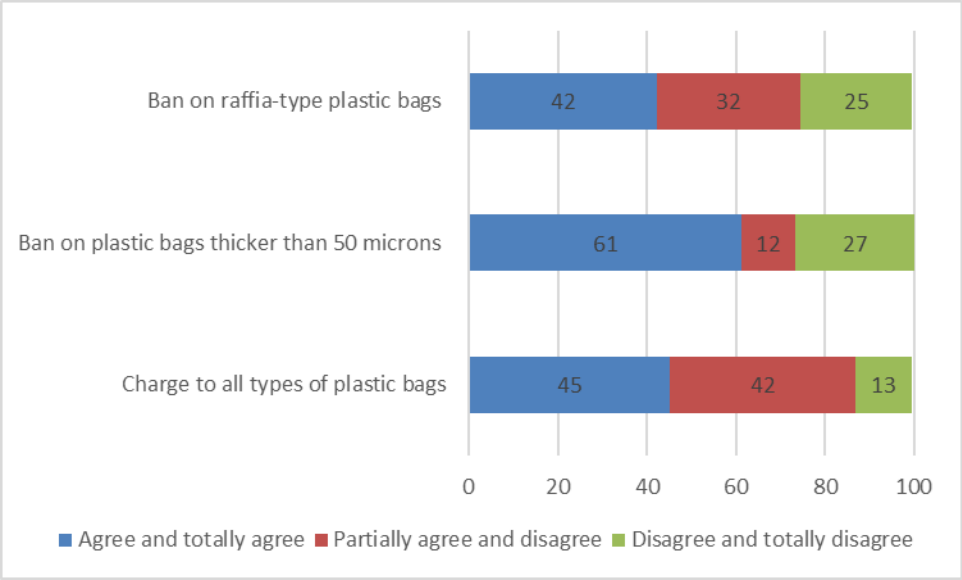

Figure 3. Attitudes towards charge changes.

3.1.2. Societal trends on environmental issues

Risk perception of plastic products. The majority of individuals were concerned with the impacts of everyday plastic products, particularly in the environment but also in health. Although the Eurobarometer data was recent (2017), there was an increase in the concern regarding the environmental impacts (91% to 96.2%). Regarding health impacts, the changes were not significant (77% to 76.2%).

Environmental concern. Most individuals were willing to pay higher taxes and higher prices, and to accept cuts in their standard of living, to protect the environment. Comparing with

ISSP 2010 data for Portugal, all measures are more positive. The increase is most visible in willingness to pay higher taxes (23% to 44%) and higher prices (17% to 33%), rather than in willingness to accept lifestyle changes to protect the environment (31% to 37%).

3.2 Economic impacts

3.2.1 Lightweight plastic bags

According to the information reported by the AT[2], since the Green Tax Reform was implemented there has been a sharp fall in the use of lightweight plastic bags (Table 1).

Table 1

Plastic Bags Subject to the Charge. Source: AT

	2015	2016	2017
Lightweight plastic bags for consumption	2.489.540	479.660	242.450
Revenue	€ 199.162,96	€ 38.372,96	€ 19.395,92

It should be noted that 85% of the bags made available to the consumer in the first year of application of the charge were the result of stock liquidation.

Between 2015 and 2016, there was a reduction of the lightweight bags that are not subject to the charge (food, donations and exports). The first two are in line with the behavioural changes seen in the psychosocial analysis. (Table 2).

[2] Under article 15 of the Executive Order 286-B/2014 of 31 December

Table 2

Plastic Bags not Subject to the Charge.

	2015	2016	2017
Plastic bags for food and ice storage	92.848.500	77.154.000	n.a.
Plastic bags for charity donation purposes	1.183.350	647.100	1.246.500
Plastic bags for exports to EU	728.959.020	583.640.510	n.a.

Previous data and the Statistics Portugal (Instituto Nacional de Estatísticas – INE) annual estimates for resident population allow us to determine the per capita lightweight bags in Portugal (excluding bags for exports) for 2015 (9.3 bags / inhab) and 2016 (7.6 bags / inhab).

3.2.2 Production and distribution of plastic bags

For a fuller understanding of impacts, the indirect effect of the lightweight plastic bag charge on other types of plastic bags also needs be assessed. Unlike lightweight bags, whose reporting is mandatory under the charge, there is no detailed information for other bags. We present INE data as well as industry reported values for the production and sale of plastic bags.

Data on "Bags of any size made of ethylene polymers"[3] , reveal a fall in production by around 22% between 2014 and 2015, with a slight recovery in 2016 (Figure 3A). In terms of sales revenue the effect is much more moderate, with only a slight drop of 3% from 2014 to 2015, plus a similar reduction in 2016 (Figure 3B).

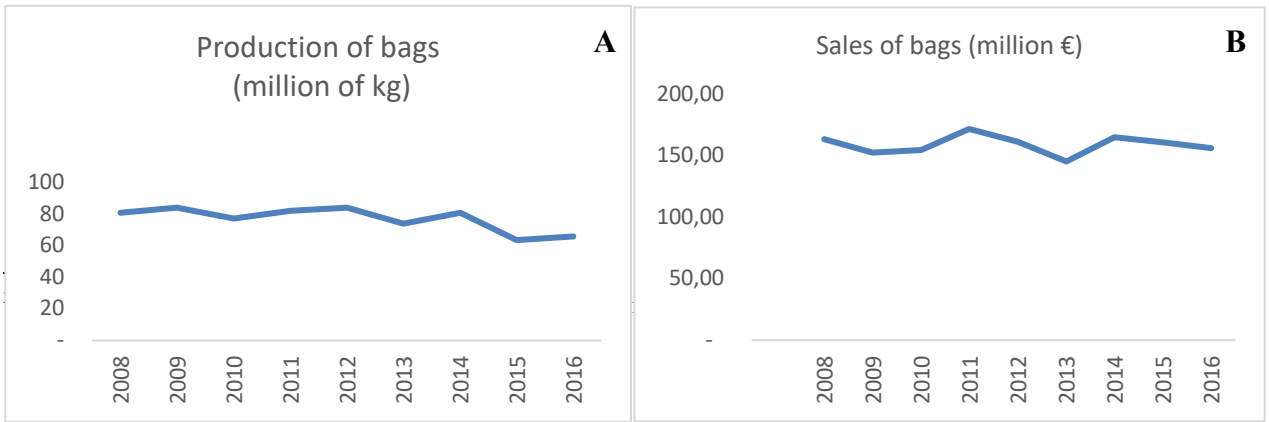

Figure 3. Production (A) and sales (B) of bags.

Ideally, we would like to evaluate bag numbers for the various relevant categories (lightweight bags, bags thicker than 50 μm and garbage bags[4]) as well as bag weight as this is an indicator of the use of raw materials. This information was not available in official statistics, so we used data provided by two firms - Silvex and Alberplás – who in 2015 accounted for about 60% of the quantity of lightweight plastic bags placed on the market and are therefore considered representative of the sector (Figure 4).

The significant reduction of lightweight bags between 2014 and 2016 contrasts with the increase observed in other categories of bags. Indeed, there was a 94% reduction in the number of light bags between 2014 and 2015, reaching 98% if we compare 2014 with 2016. In 2017, although the data does not cover the full year, there was a slight recovery in the number of lightweight bags, possibly due to the evolution in charge-exempt bags (taking into account the data in Table 2). On the other hand, there was a considerable rise in bags with more than 50 μm, whose use increased by eight to nine-fold (variation of 790% between 2014 and 2015 and 872% comparing 2014 with 2016). The use of garbage bags also increased from 2014 to 2015, although much less significantly (about 30%).

[4] Reliable information regarding raffia bags was not available.

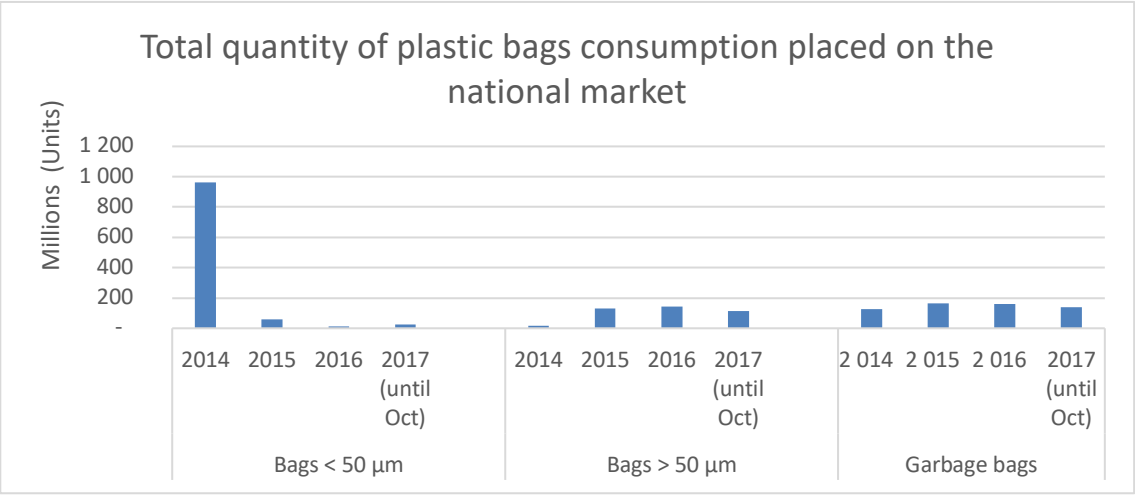

Figure 4. Quantity of plastic bags placed on the national market. Source: Silvex, Alberplás.

Looking at the data so far, the charge has been a success. Even considering bag substitutions, the total number fell about 70% in two years (from about 1102 million bags in 2014 to 315 million in 2016). However, this analysis may be misleading, since plastic bags have different characteristics and therefore their environmental impacts are not equivalent. The total weight of the bags placed on the national market can shed some light on this issue as it gives indication of the amount of raw material used in manufacturing. Figure 5 shows that, despite the replacement of the lightweight bags with thicker and thus heavier ones, there was still a substantial reduction in weight (from 10.6 to 6.6 million kg between 2014 and 2016, almost 40%).

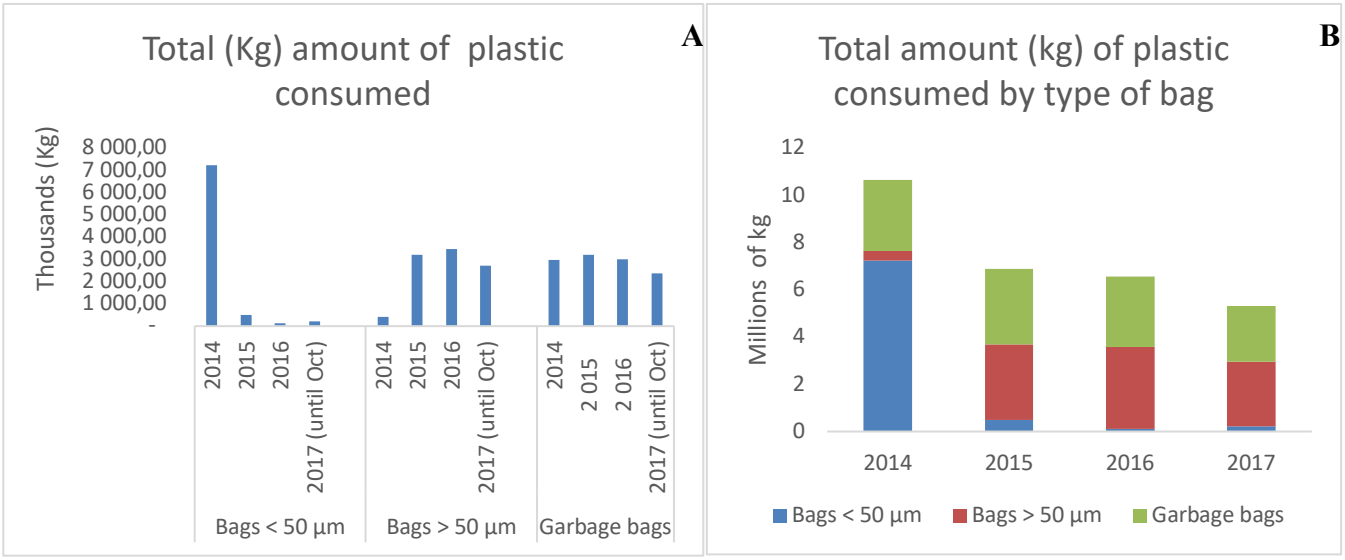

Figure 5. Total quantity of plastic consumed. Source: Silvex, Alberplás.

3.2.3 Context

During the public consultation phase of the Green Tax Reform, there were concerns on the potential negative impacts on the national plastic industry. A brief characterization of the industry can highlight the statistically visible changes, in particular in the number of companies, net profit and turnover for the following aggregates[5]: i) code 22220 "Manufacture of plastic packaging goods", that encompasses the directly affected companies; ii) code 22 "Manufacture of rubber and plastic products"; iii) code 47111 "retail trade in supermarkets and hypermarkets"; and iv) "all other activities" that are part of the Portuguese businesses, for comparison. The values are in index form, base year 2010.

It appears that Code 22220 companies have not developed negatively in the national context. The number of companies (Figure 6) declined in 2013 but then increased again; the variations in net results (Figure 7A and B) have not been harmed by the charge. Moreover, if we

[5] Organized based on the Portuguese Classification of Economic Activities (CAE Rev. 3)

consider only the overall evolution between 2010 and 2016, it was quite positive for the industry when compared with economic activity as a whole (Figure 7A)[6].

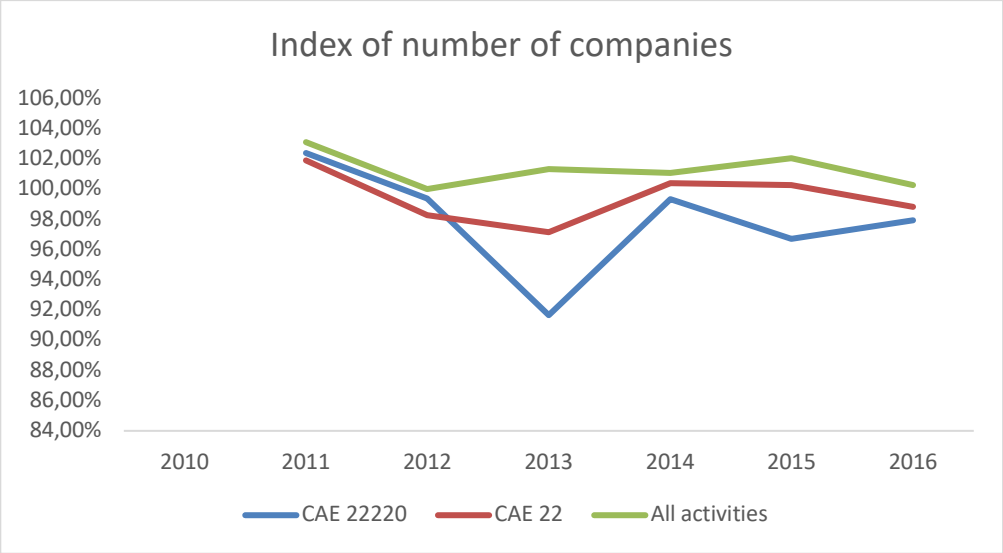

Figure 6. Number of companies. Source: Bank of Portugal.

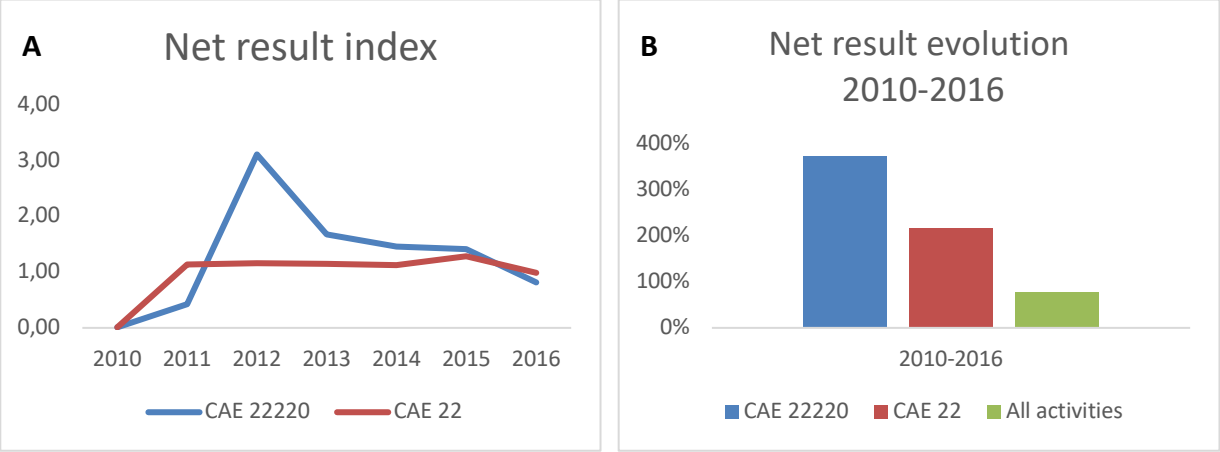

Figure 7. Net result index (A) and net result evolution (B). Source: Bank of Portugal.

[6] Figure 7A omits the evolution of all activities due to the sharp decline in 2013, a year of austerity, which if shown in the same chart would overshadow the evolution in the subsectors of interest).

Trends in turnover (Figure 8) reveal a significant drop in 2014 and 2016, but not 2015, for code 22220. There does not appear to be a strong correlation between Code 22220 firms, division 22 as a whole, and activity economic in general. The indicator for Code 47111, "retail trade in supermarkets and hypermarkets" is included in the figure since most consumption of plastic bags arises in this activity.

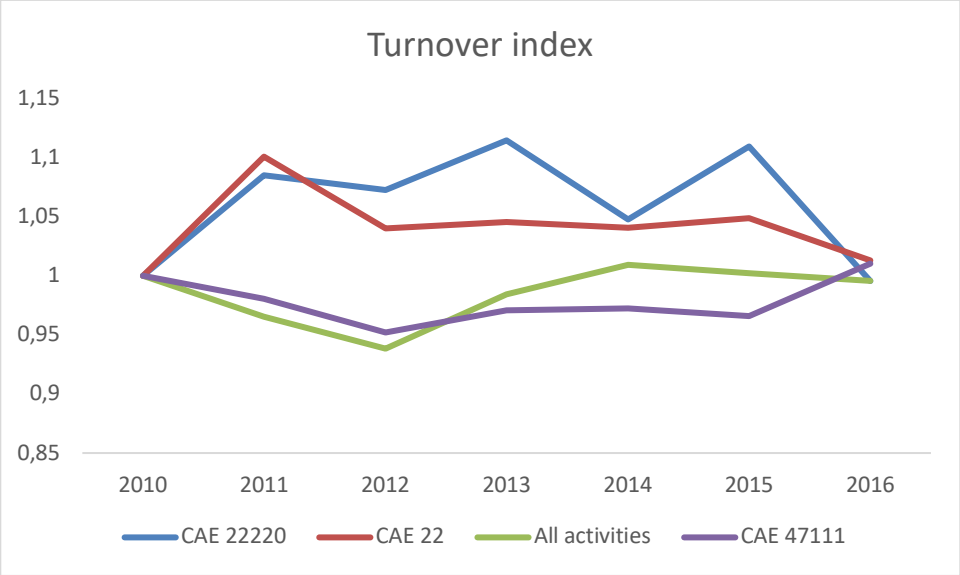

Figure 8. Turnover. Source: Bank of Portugal.

Finally, it would be interesting to ascertain the possible impact of the charge on plastic waste generation and recycling. Unfortunately, there is no information regarding the weight of plastic bags in plastic waste (generated or recovered). Despite this shortcoming, based on the specific legislation that sets out plastic waste recovery and recycling targets, the targets (referred to 2011) have already been surpassed for both packaging waste as a whole and for plastic packaging waste (Fernandes et al., 2017). The share of plastic bags in this waste stream is, however, of little significance. For instance, in 2015, of the 1.6 million tonnes of packaging waste

(INE[7] data), the weight of plastic bags was below 11000 tonnes (section 3.2.2) which corresponds to 0.5%.

4. Discussion

4.1 Psychosocial impacts

Three years after the implementation of the charge, the survey illustrated that many individuals did not know which types of bags were covered by the charge and incorrectly assumed this was being applied to thicker bags, rather than recognizing that their money was actually paying retailers for grocery bags. Still, the proportion of people who believed that the charge's goal was to increase tax revenue decreased over time, and more people agree that the charge has environmental aims.

Overall, the impacts of the charge seem positive. First, individuals developed bag reuse habits. Second, more individuals report positive spillover effects (a decrease in the use of disposable plastics and an increase in the separation of waste) than negative spillover effects (a reduction in waste separation due to the loss of the free lightweight bags to place it in). Third, most individuals appear willing to extend the charge to other types of bags.

In addition, environmental issues, in particular plastic waste, appear to have gained societal relevance over the past years. Cross-sectional comparisons suggest that individuals have increased their risk perception towards the environmental impacts of everyday plastics. Also, individuals are much more willing to pay higher taxes and prices to protect the environment.

4.2 Economic impacts

The economic analysis has led to two main findings. First, the lightweight-bag charge brought about a reduction in the use of plastic bags as a whole. Even though there was some

[7] www.ine.pt

replacement of lightweight bags with heavy ones, the 40% decrease in the total weight of plastic bags suggests that most lightweight bags have been replaced with other durable alternatives such as raffia bags or shopping trolleys. The contextual analysis suggests that the sharp drop in plastic bags was due to the charge, since the data did not show correlation between the Code 22220 "Manufacture of plastic packaging goods" and the other aggregates. Second, concerns raised during the public consultation on the possible negative effects of the charge on the national industry seem unfounded since the reduction in plastic bags does not appear to have harmed the industry.

5. Conclusions

The current production, consumption, and management of plastic waste is not sustainable, and many countries have been implementing measures to manage it. Portugal chose to begin with a charge on lightweight plastic carrier bags. This study gauged how environmental perceptions have evolved and how the economy has responded to the charge, not only to analyse its impacts but also to explore the viability of additional measures. Results were very encouraging. Individuals agreed not only with the current charge but also with widening it to all types of plastic bags. They adopted reused bags and reduced consumption of disposable plastics. Furthermore, individuals are becoming more concerned with the impacts of everyday plastic products in the environment, and more willing to pay higher taxes and prices to protect the environment. In the same vein, economic data illustrates a major drop in the use of lightweight bags, as well as in the production and sale of plastic bags, with no significant damages on the economic activity of the plastics manufacturing sector. Combined, these results illustrate that the implementation of the charge was quite successful. No societal or economic barriers should be expected from carrying on, to implement

bolder measures such as the ones derived from the European Strategy for Plastics in a Circular Economy (European Commission, 2018).

Despite the promising results of the levy, results should be interpreted with caution. This research is the first to present insights regarding the results of the plastic-bag levy for Portugal. Since the levy was introduced in 2015, the time series was short, which limited the economic analysis. The small number of observations prevented the application of more sophisticated statistical techniques. If a longer and/or more detailed time series becomes available, the research findings can be stronger.

An important issue in many studies is the lack of information on alternative types of bags. Our study shows that this is a significant aspect in the assessment of the overall environmental impact of lightweight plastic bag elimination. Further studies should gather more data on the alternative bags, using consumer surveys and industry data, in order to achieve a more comprehensive analysis. Moreover, the external costs of the different plastic bags and alternative carrying options (such as cloth bags or shopping carts) could be assessed for a fuller picture, for example through life-cycle assessment. Future research could provide a more thorough analysis, including a longer time span and/or more frequent data points, in order to improve the assessment of bag substitution. Notwithstanding the limitations, our study provides useful information on the short-term socioeconomic impacts of this levy.

References

Al-Salem, S.M., Lettieri, P., Baeyens, J., 2009. Recycling and recovery routes of plastic solid waste (PSW): A review. Waste Manag. https://doi.org/10.1016/j.wasman.2009.06.004

Chambers, R.L., Skinner, C.J., 2003. Analysis of Survey Data, Analysis of Survey Data. John Wiley. https://doi.org/10.1002/0470867205

Convery, F., McDonnell, S., Ferreira, S., 2007. The most popular tax in Europe? Lessons from the Irish plastic bags levy. Environ. Resour. Econ. 38, 1–11. https://doi.org/10.1007/s10640-006-9059-2

Eurobarometer, 2017. Attitudes of European Citizens towards the Environment, Special Eurobarometer. https://doi.org/10.2779/25662

European Commission, 2018. A European Strategy for Plastics in a Circular Economy.

European Commission, 2017. Breaking bag habits | Environment for Europeans [WWW Document]. URL https://ec.europa.eu/environment/efe/news/breaking-bag-habits-2017-11-24_en (accessed 1.26.20).

Fernandes, A.C., Guerra, M.D., Ribeiro, R., Rodrigues, S., 2017. Relatório do Estado do Ambiente 2017.

Gardner, B., Abraham, C., Lally, P., de Bruijn, G.-J., 2012. Towards parsimony in habit measurement: Testing the convergent and predictive validity of an automaticity subscale of the Self-Report Habit Index. Int. J. Behav. Nutr. Phys. Act. 9, 102. https://doi.org/10.1186/1479-5868-9-102

Geyer, R., Jambeck, J.R., Law, K.L., 2017. Production, use, and fate of all plastics ever made. Sci. Adv. 3, e1700782. https://doi.org/10.1126/sciadv.1700782

GHK, 2007. Assessment of Benefits and Effects of the Plastic Shopping Bag Charging Scheme.

Instituo Nacional de Estatística, 2011. Instituto Nacional de Estatística, Censos 2011 [WWW Document]. URL http://censos.ine.pt/xportal/xmain?xpgid=censos2011_apresentacao&xpid=CENSOS (accessed 2.15.18).

ISSP Research Group, 2012. International Social Survey Programme: Environment III - ISSP 2010. https://doi.org/ZA5500 Data file Version 2.0.0,10.4232/1.11418

Jakovcevic, A., Steg, L., Mazzeo, N., Caballero, R., Franco, P., Putrino, N., Favara, J., 2014. Charges for plastic bags: Motivational and behavioral effects. J. Environ. Psychol. 40, 372–380. https://doi.org/10.1016/j.jenvp.2014.09.004

Macintosh, A., Simpson, A., Neeman, T., Dickson, K., 2020. Plastic bag bans: Lessons from the Australian Capital Territory. Resour. Conserv. Recycl. 154, 104638. https://doi.org/10.1016/j.resconrec.2019.104638

Martinho, G., Balaia, N., Pires, A., 2017. The Portuguese plastic carrier bag tax: The effects on consumers' behavior. Waste Manag. 61, 3–12. https://doi.org/10.1016/j.wasman.2017.01.023

Newman, S., Watkins, E., Farmer, A., Brink, P. Ten, Schweitzer, J.P., 2015. The economics of marine litter, in: Marine Anthropogenic Litter. Springer International Publishing, pp. 367–394. https://doi.org/10.1007/978-3-319-16510-3_14

O'Brien, J., Thondhlana, G., 2019. Plastic bag use in South Africa: Perceptions, practices and potential intervention strategies. Waste Manag. 84, 320–328. https://doi.org/10.1016/j.wasman.2018.11.051

Poortinga, W., Whitmarsh, L., Suffolk, C., 2013. The introduction of a single-use carrier bag charge in Wales: Attitude change and behavioural spillover effects. J. Environ. Psychol. 36,

240–247. https://doi.org/10.1016/j.jenvp.2013.09.001

Schmidt, L., Truninger, M., Guerra, J., Prista, P., Grande, P., Sobre Sustentabilidade, I., 2016. Primeiro Grande Inquérito sobre Sustentabilidade [WWW Document]. Agosto, 2016. URL https://www.sonae.pt/fotos/editor2/grande_inquerito_sobre_sustentabilidade_final.pdf (accessed 9.20.17).

Thomas, G.O., Poortinga, W., Sautkina, E., 2016. The Welsh Single-Use Carrier Bag Charge and behavioural spillover. J. Environ. Psychol. 47, 126–135. https://doi.org/10.1016/j.jenvp.2016.05.008

Thomas, G.O., Sautkina, E., Poortinga, W., Wolstenholme, E., Whitmarsh, L., 2019. The English Plastic Bag Charge Changed Behavior and Increased Support for Other Charges to Reduce Plastic Waste. Front. Psychol. 10. https://doi.org/10.3389/fpsyg.2019.00266

Zambrano-Monserrate, M.A., Alejandra Ruano, M., 2020. Do you need a bag? Analyzing the consumption behavior of plastic bags of households in Ecuador. Resour. Conserv. Recycl. 152, 104489. https://doi.org/10.1016/j.resconrec.2019.104489