



# A price is a guide: The English plastic bag charge and measuring the internalisation of law

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# A price is a guide: The English plastic bag charge and measuring the internalisation of law

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## Abstract

We measure the behavioural and motivational impacts of a legislative change in England that required supermarkets to charge for new plastic carrier bags they issued. Using a difference-in-difference estimator, we find that the treatment group used 1.7 less new plastic bags per shopping trip after seven weeks. We also find evidence of motivational ‘crowding in’. That is, we find increased motivation to reduce plastic bag use and acceptance of the government’s role in regulating their use. Using mediation analysis we find that the price effect of the charge grows over time, whereas the internal motivation effect falls (in relative terms). Seven weeks after the legislation came into force the price change explains 90% of the reduction in new plastic bags used, while the change in motivation explains only 10% of the reduction.

**Keywords:** *internalisation of law, expressive law, crowding in, external and internalised motivations.*

**JEL codes:** *Q5; D1; K1; C4.*



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## 1. INTRODUCTION

Imposing a charge on a consumer good creates an incentive to reduce its use through a price effect. However, such a charge can also affect a consumer's internalised motivations (Perino et al., 2014, Dreves et al., 2014). These changes can either amplify (crowd in) or militate against (crowd out) the price incentive that has been imposed to guide consumer behaviour, with important policy consequences. We study the behavioural and internalised motivational effects of the introduction of the mandatory carrier bag charge that was implemented in England on 5 October 2015. From this date supermarkets and other large retailers in England were required by law to charge at least 5 pence for single-use plastic carrier bags. The legislative change followed the introduction of mandatory charges in Wales in October 2011, Northern Ireland in April 2013, and Scotland in October 2014.<sup>1</sup>

The plastic bags charge was introduced to reduce the use of carrier bags and the litter associated with their improper disposal. In outlining the rationale for the charge, the UK Government (2015) concluded that single use plastic carrier bags 'take longer than other bags to degrade in the environment, can damage wildlife, and are extremely visible when littered in our towns, parks and the countryside'. It went on to cite benefits of £6

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<sup>1</sup> The Republic of Ireland was the first country to require the mandatory charging of plastic carrier bags in 2002, and since then a number of other jurisdictions across the world have followed suit.

million per year in savings from litter clean-up costs and £1.3 million per year in carbon savings. In addition, as retailers are required to donate the funds raised to ‘good causes’, it also included up to £73 million per year to be given to charity.

Prior to the introduction of the mandatory charge, the government used voluntary schemes to try to reduce their use. In 2008 the British Retail Consortium (that represents larger supermarkets) signed up to a voluntary agreement which saw the distribution of plastic bags almost halve in 2009 compared to their peak in 2006 of 12.1 billion (House of Commons, 2014, WRAP, 2015).<sup>2</sup> With the exception of one retailer (Marks & Spencer), who introduced a charge on plastic bags voluntarily (discussed below), retailers agreed to reduce the uptake of new plastic bags by making them less accessible to consumers. However, despite an initial large reduction, plastic bag use began to rise again, by approximately 4 per cent per annum to 8.5 billion in 2014 (WRAP, 2015). In explaining its decision to introduce the charge, the UK Government (2015) cited the fact that the use of plastic carrier bags had increased for five years in a row.

The House of Commons Environmental Audit Committee (House of Commons, 2014, page 7), concluded that ‘[d]iscarded plastic bags are an iconic symbol of waste’, and reported that a number of coalitions were formed in the UK to campaign against their use, including the ‘break the bag habit’ group. Indeed, surveys suggest that support for a mandatory charge has been growing in England in recent years and that before the charge was introduced, the majority of consumers were in favour of it<sup>3</sup> (62%, a value that compares well to the 63% of English shoppers in our survey before the charge was introduced). Despite a majority supporting the introduction of a mandatory charge, some believed that it was an unnecessary intrusion on consumer sovereignty and there have been reported cases of resistance and non-compliance. For instance, following the introduction of the charge there were reports of an upsurge in basket thefts from some supermarkets (resulting in them being security tagged in stores) and there have been reports of widespread non-compliance by consumers using self-checkouts that require consumers to self-report the number of single use carrier bags they use<sup>4</sup>.

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2 Citing data collected from WRAP, the House of Commons report that the reduction was 48% from 2006 to 2009 (compared to the target of 50%). WRAP (2015) report that 12.1 billion plastic carrier bags were distributed in 2006 and that this fell to 7.2 billion in 2009/10 for the UK. Since then they show an increase each subsequent year (approximately 4 per cent). The total number of bags distributed in 2014 was 8.5 billion in the UK (7.6 billion in England).

3 Reported in BBC: Plastic bag charge: Shoppers in England have to pay 5p (5 October 2015). <http://www.bbc.co.uk/news/business-34438030>. Accessed January 2016.



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Given divergent views over plastic bag use, and the staggered introduction of a mandatory charge across the UK, its introduction in England provides an opportunity to test its behavioural and internalised motivational consequences. It enables us to answer two fundamental questions in relation to the imposition of a charge to alter consumer behaviour: 1) To what extent can a government imposed charge lead to a change in social values?; and 2) To what extent is the change in behaviour attributed to the price effect of the charge itself and to what extent is attributed to a change in internalised motivation?

## 2. THEORETICAL DISCUSSION

Titmuss (1971), Frey (1992), Gneezy and Rustichini (2000) and many others have highlighted how internalised motivations can be altered through the introduction of monetary incentives. This literature suggests that a behavioural response in relation to the introduction of a financial incentive consists of both price and internalised motivational effects. While the effect of a price change generated by the introduction of a financial incentive is relatively straightforward (assuming that the demand curve is downward sloping), the effect it can have on internal motivation can be more complex. The introduction of a financial incentive may reduce (crowd out) or increase (crowd in) internal motivation (e.g. Bowles and Polania-Reyes, 2012). Furthermore, numerous mechanisms have been identified that can generate these crowding in and crowding out effects.

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4 See on the BBC: Oldham Tesco baskets stolen after bag charge introduced (14 October 2015) <http://www.bbc.co.uk/news/uk-england-manchester-34522034>; on The Telegraph: English shoppers steal £26.7m worth of plastic bags since 5p charge introduced (13 January 2016). Early reports by one large retailer suggest that plastic bags issued have fallen dramatically since the introduction of the charge. See Guardian: Plastic bag usage down 78% since introduction of 5p charge, says Tesco <http://www.theguardian.com/environment/2015/dec/05/plastic-bag-usage-down-78-since-introduction-of-5p-charge-says-tesco>. Accessed January 2016. <http://www.telegraph.co.uk/news/earth/environment/12097146/English-shoppers-steal-26.7m-worth-of-plastic-bags-since-5p-charge-introduced.html>; and on The Telegraph: Card Factory dodges government's 5p plastic bag tax by snipping off handles (28 January 2016) <http://www.telegraph.co.uk/news/earth/environment/12128161/Card-Factory-dodges-governments-5p-plastic-bag-tax-by-snipping-off-handles.html>

In terms of financial incentives acting to reduce internal motivation, mechanisms that have been identified include: control aversion and frustration generated by a third party seeking to alter their behaviour (Gneezy et al., 2011, Frey and Stutzer, 2008, Bowles, 2008, Goeschl and Perino, 2012); reduced internal satisfaction or ‘warm glow’ as individuals no longer feel good about themselves as they did when acting on a voluntary basis (Bowles and Polonia-Reyes 2012, Frey and Stutzer 2008); reduced image motivation from being unable to signal to others that they are a ‘good person’ (Gneezy et al., 2011); release from moral responsibility (Frey, 1992); and frame shifting (e.g. moving the decision from a moral to an economic one (Frey, 1992, Cardenas et al., 2000)).

While the literature has focused more on crowding *out* than *in* (Rode et al., 2015, Frey and Stutzer, 2008), mechanisms have been identified that generate increased internal motivation from the imposition of financial incentives. In particular, legal scholars such as Cooter (1998), McAdams (1997), and Sunstein (1996) have highlighted the ‘expressive function’ of law that can lead to a form of crowding in through a process of internalisation. That is, the state makes a ‘statement’ about appropriate behaviour through legislative change that can then lead to a change in prevailing norms, preferences and beliefs. Etzioni (2000, page 167) observes that ‘internalisation is a remarkable process through which imposed obligations (compliance with which must be forced or paid for) become desires’. Once a law is internalised, some scholars such as Cooter (1998) and McAdams (1997) suggest that a psychological penalty (e.g. guilt, shame) can apply to the act, which discourages the negative behaviour beyond the actual price. For example, before the charge was introduced, there may have been no psychological cost associated with using a plastic bag for a single shopping expedition; however, once the charge is introduced to reduce consumption, a norm concerning the belief that plastic bags are used excessively may become internalised. Consequently, each extra bag used may generate a physiological cost in the form of guilt or other negative emotions associated with its use.

Mechanisms that generate the expressive function of the law include signalling benefits from network externalities that can lead to a change in internalised preferences (Cooter 1998, Bar-Gill and Fershtman 2004, and Sunstein 1996). In this sense, a change can signal (and generate) increased returns from adopting a new norm of behaviour. For instance, Cooter (1998, page 608) considers that ‘coercive state sanctions can induce people to internalise norms by creating opportunities for Pareto self-improvement’. He suggests that a Pareto self-improvement is generated when commitment to the new norm produces an advantage relative to an individual’s original preferences, which can come about through a new social equilibrium that favours those who adhere to the new norm. In this sense, a legislative change signals the benefits of adopting a new norm as well as generating a new social equilibrium. For instance, the increased returns from the legislative

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change could be generated by correcting for a co-ordination (or free-rider) problem that could otherwise result in perceived inequality between compliers and non-compliers. For example, as noted by Rode et al. (2015, page 271) ‘it’s easier for environmentally minded car drivers not to speed on the highway when a general “speed” limit and fine prevents other drivers from overtaking them’.

Other authors, such as Hart (1997, page 242) suggest a more straightforward mechanism for internalisation, where the *internal point of view*, is manifested by ‘accepting the law as providing guides to their conduct and standards or criticism’. Once this is done, through a process of shift in viewpoint, one moves from ‘observer’ to a ‘member’; then the member uses the law as a guide for his or her conduct and in determining what is good (or right) behaviour. Hart’s analysis implies that if one does internalise the law, then a legal change will induce changes in attitudes toward the behaviour in question as well as the regulatory space occupied by the legislator. For instance, citizens may internalise both the norm of minimising plastic bag use (or re-using them) and the state’s authority in aiming to minimise plastic bag use through imposing a mandatory charge.

In light of the discussion above, we can expect a new law requiring retailers to charge their customers for new plastic bags to impact on consumption in two ways. The first is the price effect while the second is the internalised (crowding in or crowding out) effect. Therefore, the total effect of the imposition of carrier bag charge can be decomposed into the following components:

$$\frac{\partial x_i}{\partial p} = \frac{\partial x_i^p}{\partial p} + \frac{\partial x_i^m}{\partial p} = \frac{\partial x_i^p}{\partial p} + \frac{\partial x_i^m}{\partial M} \frac{\partial M}{\partial p} \quad (1)$$

where  $x$  represents the number of plastic bags used for consumer  $i$ ,  $x^p$  represents the external price effect, and  $x^m$  = internal motivation effect, and  $p$  is the price of the plastic bag. Drawing on the law of demand, we can expect the price effect  $\partial x_i^p / \partial p$  to be negative, while the internalised motivation effect would be negative (e.g. a decline in plastic bags) if crowding in occurs and positive if crowding out occurs. Therefore, if the charge led to crowding in of internalised motivations, the price effect would be magnified by internalised motivations. Alternatively, if the charge led to crowding out of internalised motivations, the impact would be ambiguous, depending on the relative size of the price effect and internal motivation effect.

In summary, along with a price effect we can expect to observe an internalisation effect. The price effect is predicted to have a negative effect on plastic bag consumption. In terms of internalised motivations, if the new law introducing a carrier bag charge is internalised, it should increase the intrinsic motivation to minimise bags use, leading to a further decline in plastic bags used. Under Hart’s analysis, this internalisation should be

generated by the mere fact that law has changed and that it is used as a guide for what is deemed to be right. Internalisation of the law can take two aspects: one focused on the rightful place of government involvement in consumer or business decisions (i.e. the government is right to interfere in the market); and a second by modifying their attitudes toward use of plastic bags. If internalisation is generated by signalling increased returns from adopting a new norm, we would expect to see beliefs around increased returns from plastic bag minimisation to increase following the legislative change.

### 3. ECONOMETRIC MODEL

#### 3.1. Difference-in-difference estimation

The objective of this exercise is to determine the impact of a legislative change that mandates a charge on new plastic carrier bags, both in terms of behaviour and internalised motivation. To this extent, imagine a consumer  $i$  of demographic characteristics  $D_i$  in week  $t$ , where  $t = 0$  before the legislative change, and  $t = 1$  indicates a period after the legislative change. The population is further divided into two groups  $s$ . Some consumers ( $s = 0$ ) already pay a charge on plastic bags on environmental grounds at  $t = 0$ , and they are not affected by the policy change at this time (the control group). Others ( $s = 1$ ) are impacted by the legislative change at time  $t = 1$  (the treated group). Plastic bag consumption of individual  $i$  in group  $s$  at time  $t$  is then defined as  $Y_{ist}$ . The total impact of the policy on the target consumers can then be written as the difference in consumption of individuals previously unexposed to the charge compared to the same difference in individuals who were previously exposed to the charge (Imbens and Wooldridge, 2009), as:

$$\beta = [Y_i(s=1, t=1) - Y_i(s=1, t=0)] - [Y_i(s=0, t=1) - Y_i(s=0, t=0)] \quad (2)$$

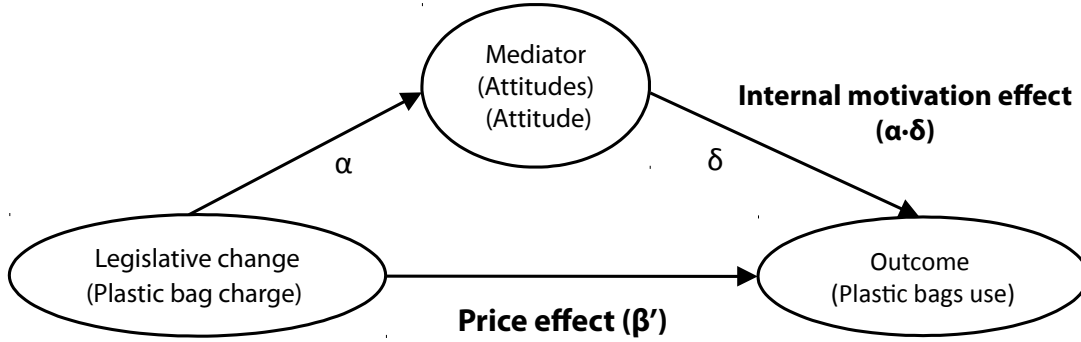
Equation (2) represents a difference-in-difference (DID) estimator of the impact of the legislative change. This effect can be estimated by the regression (Bertrand et al., 2004):

$$Y_{ist} = A_s + B_t + \beta I_{st} + \gamma D_{ist} + \varepsilon_{ist} \quad (3)$$

where  $A$  refers to group-specific fixed effects, capturing systematic differences between control group and the initially unexposed group (e.g. different plastic bags needs);  $B$  refers to time-specific fixed effects that capture the presence of the plastic bags charge if  $t > 0$ ; and  $\varepsilon$  is the error term. In equation (3),  $I$  refers to the interaction term between treatment dummy (equal to one for those initially unexposed to the charge) and the legislative change dummy. Then,  $\beta$  captures the impact of the legislative change, measuring the change in consumption of people exposed to the plastic bag charge for the first time relative to the control group who were previously exposed to the charge. Importantly, the presence of different time periods causes a problem of correlation of the residuals  $\varepsilon_{ist}$  (Bertrand et al., 2004); this problem can be significantly mitigated by clustering residuals by period, which we do (Wooldridge, 2003).

### 3.2. Mediation analysis

The DID estimator enables us to estimate the change in behaviour caused by the introduction of the charge. As discussed in section 2, part of the change is driven by the introduction of a monetary charge for the use of new plastic bags, and part is caused by a change in the intrinsic motivation of the consumer to reduce plastic bags use. The point is presented graphically in Figure 1: the introduction of the plastic bag charge has a **direct price effect** on plastic bag use, which reduces consumption of new bags by increasing the monetary cost of their use; and an **indirect internal motivation effect**, that further changes consumption by making consumers more (crowding in) or less (crowding out) sensitive to the problem of plastic bags overconsumption. The DID estimator ( $\beta$ ) of equation (3) estimates the overall change in behaviour generated by the introduction of the plastic bags charge, but does not estimate the relative importance of these two effects (a point more generally discussed in Ludwig et al., 2011). To separate these two effects, we use mediation analysis (e.g. Baron and Kenny, 1986, MacKinnon et al., 2007).

**Figure 1: Relation between policy change and behaviour**

Adapted from Ludwig et al. (2011), page 19.

To measure the direct and indirect effect of the legislative change, behaviour is modelled as a system of two equations. Firstly, consumption is modelled by extending equation (3) to adjust for the role of motivation  $X$  on demand as:

$$Y_{ist} = A'_s + B'_t + \beta' I_{st} + \delta X_{ist} + \gamma' D_{ist} + \epsilon_{ist} \quad (4)$$

Similarly, internal motivation  $X$  can be modelled as:

$$X_{ist} = C_s + F_t + \alpha I_{st} + \varphi D_{ist} + u_{ist} \quad (5)$$

where  $C$  and  $F$  reflect group-specific and time-specific motivational fixed effects. Figure 1 explains the intuition behind this two-equation system. The introduction of the plastic bag charge has a price effect that reduces the use of plastic bags by  $\beta'$  units. The charge also has an indirect effect: the legislative change increases (decreases) the average internalised motivation in the sample by  $\alpha$  units, e.g. increasing (decreasing) the belief that plastic bags are overconsumed; because each unit of motivation influences behaviour by  $\delta$  units, the charge will further reduce (increase) consumption by  $\alpha \cdot \delta$  units.

Merging equations (4) and (5), we then obtain the aggregate equation:

$$Y_{ist} = (A'_s + \delta C_s) + (B'_t + \delta F_t) + (\beta' + \delta\alpha)I_{st} + (\delta\phi + \gamma')D_{ist} + (\delta u_{ist} + \epsilon_{ist}) \quad (6)$$

which is equivalent to equation (3). In equation (6), the total effect of the policy is:

$$\hat{\beta} = (\beta' + \delta\alpha) \quad (7)$$

which is the sum of a direct effect ( $\beta'$ ) and an indirect effect ( $\delta\alpha$ ), as in Figure (1). The standard error of the indirect effect equals  $\sigma_{\alpha\delta} = \sqrt{\sigma_\alpha^2 \delta^2 + \sigma_\delta^2 \alpha^2}$  (Krull and McKinnon, 2001). Notably, mediation analysis identifies causal effects only if two conditions hold (Keele et al., 2015). First, the charge has to be randomly assigned, i.e. the treatment variable  $D$  in equation (4) has to be unrelated to unobservable preferences for plastic bags after adjusting for covariates. Secondly, attitudes must be exogenous to the behaviour given the remaining covariates, i.e. the main relation is structural. These points are discussed in more detail in section 7, when some robustness checks test whether these two conditions hold.

## 4. DATA

### 4.1. Survey design

To measure the impact of the plastic bag charge on English consumers, data on the consumption of plastic bags and attitudes was collected through three subsequent cross-sectional surveys of the UK population. The requirement to charge for plastic bags came into force in England on October 5<sup>th</sup>, 2015. To assess consumption and attitudes before the introduction of the charge, the first survey took place on the 29<sup>th</sup>-30<sup>th</sup> of September 2015<sup>5</sup>. A second survey collected data one week after the introduction of the policy, on the 13<sup>th</sup>-

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5 It should be noted that the introduction of charge was known in advance, so it is possible that some internalisation could have occurred prior to the charge actually coming into force. Therefore, the results capture the effect of the charge actually being implemented.

14<sup>th</sup> of October 2015. A final round was then set seven weeks after the introduction of the carrier bag charge (24<sup>th</sup>-25<sup>th</sup> November, 2015) to capture the longer-term impact of the policy on behaviour. This survey, identical across periods, collected information on the consumption of plastic bags, plus personal attitudes towards plastic bag use and its regulation. To obtain nationally representative samples, the survey used a quota-sampling strategy that set quotas for age, gender, and regional distribution of the population to match actual UK statistics. A median test shows that respondents across the three periods also do not differ significantly in terms of income ( $p=0.474$ ), and education ( $p=0.716$ ). Finally, all participants completed the survey within 5 minutes.

The need to collect a survey to measure consumption is driven by the lack of information available on plastic bag consumption. Before the introduction of the charge, plastic bags were free to take and they were not scanned at the till (they had no bar code) nor recorded by the cashier. This situation changed once the charge was introduced, as consumers had to pay for the bag and this charge appeared on the bill. To ensure the availability of the same consumption data before and after the policy was introduced, the survey used a standard recall question (Browning et al., 2003): consumers were asked to report the number of carrier bags they used during their last grocery shopping trip when they used some. Self-reported measures of behaviour are known to carry a downward bias (Schwarz, 1999, Browning et al., 2003), particularly when consumption is considered socially undesirable (e.g. alcohol in Feunekes et al., 1999). However, consumption from recall can be accurate if the questionnaire is designed correctly: recalling a specific event, which has occurred recently, and having no time restriction to answer the question has been shown to give more precise measures of behaviour (Schwarz and Oyserman, 2001). As a result, respondents were asked to base their assessment in the last grocery shopping trip and were given a scale to facilitate the task. The same recall approach was used to generate all behavioural data.

Importantly, the survey also collected information on preferences (on scales from zero to 100) that have been associated to individual responses to economic incentives. Specifically, the literature emphasises that economic incentives can influence **Intrinsic motivation**, the intrinsic pleasure of an act (Kreps, 1997, Besley and Ghatak, 2016), which were measured using the statement “Minimising the number of plastic carrier bags when I shop for groceries is important to me, regardless of any benefit or inconvenience that may result”. Similarly, compliance with a law or policy depends on **Control aversion** (Bowles and Polania-Reyes, 2012), which is captured by the statement “The government should not interfere by requiring retailers to charge for plastic carrier bags”; **Free Riding** (e.g., Andreoni, 1988) is measured by to the statement “Other customers will continue using plastic carrier bags even if I stop using them”; and **Moral engagement** (Bowles and Polania-Reyes, 2012), measured by the statement “Shoppers



have a moral obligation to minimise the use of plastic carrier bags”. Finally, the **Informational role** of the legislative change (Geisinger and Stein, 2016), which communicates the intention of the principal in the implementation of a law, was captured through the statement “Plastic carrier bags are currently overused”.

## 4.2. Identification strategy

As defined in section 3, the impact of the plastic bag charge is identified using a difference-in-difference estimator. This type of estimator requires variability in the sample along two dimensions: firstly, the sample should contain information of behaviour before and after the policy is introduced; secondly, in both periods the sample should include a number of individuals who are not affected by the policy when this is implemented, which represent a control group against which changes are compared (see also Bertrand et al., 2004 for more details on the method). The present dataset contains information on plastic bag consumption before as well as after the charge was introduced. The treatment-control dimension of the estimator is captured by variation within UK supermarkets. First, the market presented institutional differences: specifically, Wales introduced a plastic bag charge on the 1<sup>st</sup> of October 2011, followed by Northern Ireland on the 1<sup>st</sup> of April 2013, and from Scotland on the 20<sup>th</sup> of October 2014. Second, one retailer chain introduced the charge voluntarily: Marks & Spencer (M&S) started charging 5p for plastic bags across the UK using an explicit environmental rationale from February 2008 and donating the resulting profits to charity<sup>6</sup>.

UK supermarkets represent a setting that lends itself to a quasi-experimental design: the plastic bags charge mattered only for English consumers who did not shop in M&S. The remainder of the sample is the control group, which captures those consumers who were already paying for plastic bags on environmental grounds. Table 1 observes that around one third of consumers had shopped in M&S in the four weeks leading to the survey<sup>7</sup>, and the sample shows no major shift in the choice of retailer brand, with consumers on average visiting about 4 different retailer brands per month. Notably, the choice of control group is crucial to obtain unbiased estimates using a difference-in-

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6 See <http://corporate.marksandspencer.com/blog/stories/carrierbagcharge>, and <http://www.thisismoney.co.uk/money/bills/article-3254567/Clothes-shops-charge-5p-carrier-bag-Monday.html>

7 Notably, only 2 individuals in each round of surveys shopped exclusively in Marks & Spencer, indicating that only 0.2% of the population had only access to stores that charged for plastic bag use.

difference estimator, due to unobservable preferences for the environment before the plastic bag charge was introduced. Specifically, a control group that erroneously includes individuals who hold strong preference for the environment before the legislative change is introduced would cause the failure to reject a false null hypothesis (a type II error) by showing little change after the policy is introduced. Similarly, the incorrect inclusion of individuals who are initially unexposed to the charge in the control group would result in a significant change in consumption in response to the legislative change, favouring the incorrect rejection of a true null hypothesis (a type I error).

**Table 1: General shopping habits of the sample**

<b>Store</b>	<b>Survey 1</b>	<b>Survey 2</b>	<b>Survey 3</b>
<b>Asda</b>	47.00%	47.56%	46.35%
<b>Aldi</b>	35.78%	34.33%	33.85%
<b>Coop</b>	27.00%	25.33%	25.66%
<b>Iceland</b>	21.44%	20.11%	22.12%
<b>M&amp;S</b>	33.00%	31.67%	32.63%
<b>Morrisons</b>	31.56%	34.22%	34.96%
<b>Lidl</b>	31.22%	28.78%	29.42%
<b>Sainsbury</b>	50.00%	50.00%	55.20%
<b>Tesco</b>	64.00%	65.22%	64.49%
<b>Waitrose</b>	20.11%	18.78%	17.92%
<b>Small local retailer</b>	17.11%	16.22%	17.15%
<b>Other stores</b>	2.89%	3.56%	3.76%
<b>Average number of stores visited</b>	3.81	3.75	3.83
<b>Observations</b>	900	900	904

## 5. RESULTS

This section estimates the impact of the introduction of the plastic bag charge on consumer attitudes and behaviour. The section starts by making an assessment of the overall change in variables across the survey. Subsequently, the section tests for changes in consumption of plastic bags over the time of this study.

## 5.1. Policy impact

A first question related to the introduction of the charge is the impact of the policy intervention, measured in terms of plastic bag consumption (new and re-used). Table 2 shows that on average *total* plastic bag use per shop in the UK decreased mildly in the weeks following the introduction of the charge, going from 4.49 to 4.18 units per person. However, average consumption of new plastic bags in the full sample dropped from around 2.55 units per person per trip to just over 1.44 bags. Figure 2 shows the distribution of the consumption of both new and all plastic bags in the three survey periods. A Kolmogorov-Smirnov test (Table 3) indicates that the distribution of total plastic bags used in the sample did not change significantly over time, while the distribution of new bags shifted toward zero. Figure 3 shows that individuals previously unexposed to the mandatory charge showed both a decline in total as well as new plastic bags (p-values for trend equal to 0.022 and 0.000, respectively). The introduction of the mandatory charge in England also significantly reduced the uptake of new plastic bags (p-value for trend = 0.000) in the group of consumers previously paying for their use, but it did not change the total number of plastic bags they used (p-value for trend = 0.901). Interestingly, Figure 3 indicates that the total consumption of plastic bags (new or used) in the group of treated converged to the same value as the control group after 7 weeks.

**Table 2: Mean behavioural and attitudinal variables in the sample**

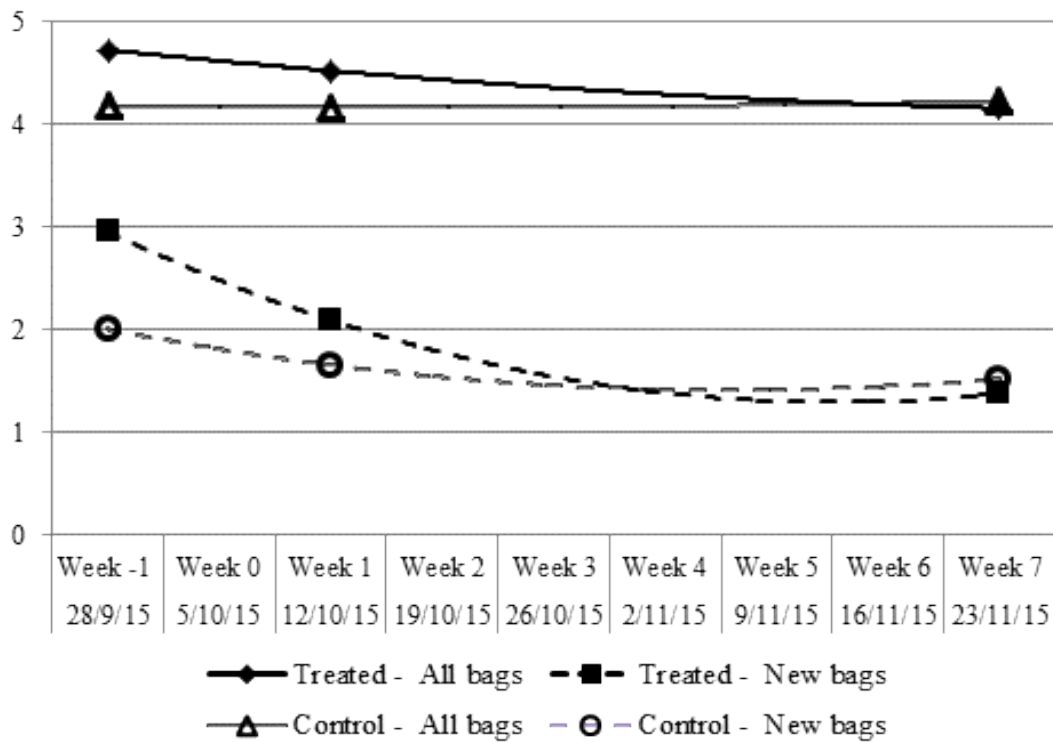
	<b>Variable</b>	<b>Survey 1</b>	<b>Survey 2</b>	<b>Survey 3</b>
<b>Behaviours</b>	<b>Bag used – All</b>	4.4878	4.3689	4.1836
	<b>Bag used – New</b>	2.5467	1.9067	1.4447
	<b>Reusable bag – carried</b>	0.6233	0.7178	0.7478
	<b>Reusable bag – purchased</b>	0.2344	0.3122	0.2777
	<b>Bin liners purchased</b>	0.2056	0.2400	0.2290
<b>Support for the charge</b>	<b>Government is right</b>	0.664	0.722	0.698
	<b>Fair charge (£)</b>	5.049	7.083	7.149
<b>Attitudes</b>	<b>Intrinsic motivation</b>	64.742	66.888	65.349
	<b>Control aversion</b>	46.107	40.823	43.016
	<b>Information</b>	71.328	73.309	69.166
	<b>Free-riding</b>	70.872	67.503	66.982
	<b>Moral engagement</b>	68.293	70.072	68.478
	<b>Observations</b>	900	900	904

Table 3: Kolmogorov-Smirnov test

		New plastic bags	Total plastic bags
		D Statistic	D Statistic
<b>Week 1 vs Week 2</b>	Increase in plastic bags	0.0000	0.0244
	Decrease in plastic bags	-0.1011***	-0.0278
<b>Week 1 vs Week 3</b>	Increase in plastic bags	0.0000	0.0000
	Decrease in plastic bags	-0.2328***	-0.0403

Significance is as follows: \* = 0.10; \*\* = 0.05; \*\*\* = 0.01.

Figure 3: Trend in average consumption of plastic bags over time



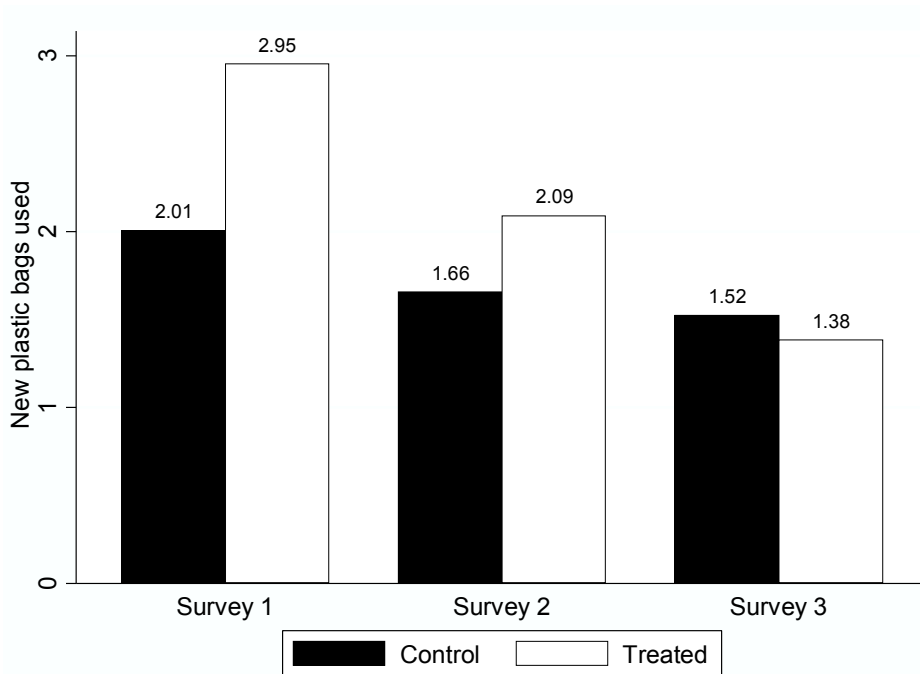
Comparing the impact of the mandatory charge on those consumers initially exposed to the plastic bag charge (i.e. shoppers in Northern Ireland, Scotland, and Wales, and English shoppers in M&S) to those who were unexposed, Figure 4 confirms that the consumption of plastic bags went down in both samples. As expected, consumption of new

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plastic bags declined much faster in consumers initially unexposed to the charge, dropping from 2.95 to 1.38. In addition, those who were already paying for new bags also reduced consumption from 2.00 to 1.52 new bags. Importantly, the consumption of new plastic bags for the whole English sample (the target of the policy) fell from 2.80 bags one week before the introduction of the charge to only 1.45 bags after seven weeks (the same value was 1.97 after one week). This suggests that new plastic bag consumption approximately halved in England in the immediate period following the introduction of the charge.

**Figure 4: Average number of new plastic bags used by survey period and treatment**



An ANOVA test indicates that the interaction between treatment and policy is significant only in period three for total bag consumption (p-value = 0.0279); while for new bags the interaction is significant both in period two (p-value = 0.0735) and period three (p-value = 0.0001). As a result, the introduction of the mandatory charge was successful in rapidly reducing the consumption of new plastic bag use, but changes in the overall consumption of plastic bags declined more slowly, reaching a significant decline somewhere between two and seven weeks after the policy was introduced. Finally, Figure 4

shows graphical convergence between the consumption of new plastic bags in both consumers initially exposed to the charge (control) and those initially unexposed (treated) after 7 weeks.

## 5.2. Evaluating consumer attitudes

In explaining how the impact of the policy intervention changed over time, we are particularly interested in evaluating how attitudes to the intervention altered over the same period. Table 2 above demonstrates changes to several attitudinal variables (as well as behavioural variables). In particular, it shows a change in support for the intervention over the different time periods. The changing attitudes toward the behaviour being regulated are indicated in the lower part of Table 2, in which consumers report week by week on how they feel about the intervention. The only behaviour registering consistent change over the course of the survey is the concern of consumers over free-riding, which declines consistently across time. All other attitudes move in the direction supporting the intervention between surveys 1 and 2, but then show less movement afterwards. This same phenomena appears in regard to the general level of support for the intervention (second part of Table 2): in the second survey period, there was an increase in support for the policy, but less change between the second and third surveys.

There is also a spatial component to the results. Table 4 shows that before the policy was implemented, some stated behaviours did not vary much across the parts of the UK, or between treated and controls: there were no significant differences between total consumption of bags, the purchase of “bags for life”, and bin liners. However, shoppers in those parts where the plastic bag charge was already in place were already using fewer new bags, and were more likely to have reusable bags on hand. As a result, the samples did not differ in their plastic bags needs, but in their already-existing level of adaptation to the charge, having overcome the need for new bags by carrying reusable bags.

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**Table 4: Comparison of measured variables across groups and countries at week 1**

	Target group (England only)		Country				chi <sup>2</sup> (3) <sup>b</sup>
	Control	Treated <sup>a</sup>	England	N. Ireland	Scotland	Wales	
<b>BEHAVIOUR</b>							
<b>Total bags used</b>	4.2875	4.7237*	4.5849	4.0000	4.1286	3.7755	6.403*
<b>New bags used</b>	2.4583	2.9533*	2.7958	0.9259	1.1714	1.5714	48.387***
<b>Reusable bag – carried</b>	0.6958	0.5447***	0.5928	0.8889	0.8143	0.6735	22.466***
<b>Reusable bag – bought</b>	0.2208	0.2471	0.2387	0.1852	0.1714	0.2857	2.705
<b>Bin liners</b>	0.2125	0.1848	0.1936	0.2963	0.3000	0.2041	5.835
<b>ATTITUDES</b>							
<b>Intrinsic motivation</b>	65.8875	62.2899	63.4350	75.2963	72.1429	68.4694	11.198**
<b>Control aversion</b>	47.5792	49.6965	49.0226	29.6296	30.0143	33.3061	36.087***
<b>Informational role</b>	74.8208	69.0992***	70.9204	80.2593	75.3714	66.8980	7.257*
<b>Free Riding</b>	71.6083	72.6031	72.2865	63.4074	62.6000	65.0408	14.443***
<b>Moral engagement</b>	68.8750	65.6673	66.6883	78.2593	78.7429	72.5714	20.092***
<b>Observation</b>	240	514	754	27	70	49	

Note: statistics refer to survey 1 only. Significance is as follows: \* = 0.10; \*\* = 0.05; \*\*\* = 0.01. <sup>a</sup>: Significance refers to an independent two-sample t-test with unequal sample sizes and unequal variances. <sup>b</sup>: significance based on a Krusal-Wallis test.

However, all the attitudinal measures differed significantly across the constituent parts of the UK (England, Scotland, Northern Ireland, Wales) (Table 4): consumers in England appeared less motivated to reuse bags, considered plastic bag use less of a problem, and were more likely to dislike government intervention than in those parts of the UK where legislation was already in force. The same attitudinal base did not vary as much between English controls and treated groups: compared to all other shoppers, M&S shoppers were only more sensitive to the problem of plastic bags overuse. As a result, English shoppers exposed to the voluntary charge had only partially internalised the charge before this came into place<sup>8</sup>.

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<sup>8</sup> Notably, the partial internalisation showed by English shoppers in M&S is supported by a significantly higher likelihood of these consumers to consider that government intervention in this field was right, and that they felt better after reusing plastic bags before the formal introduction of the charge (results available from the authors upon request).

## 6. DIFFERENCE-IN-DIFFERENCE ANALYSIS

The previous sections reported on descriptive statistics and univariate tests of differences in motivational and behavioural variables in the sample. In this section, we use the difference-in-difference estimator described in section 3 to determine the net impact of the policy intervention. In the regressions described in this section, demographic characteristics enter as follows: age is used as a linear variable, gender refers to a dummy equal to one for males, while income and education are used as two sets of dummies. Finally, attitudinal variables were measured using a continuous variable (using sliders going from 0 to 100), and enter the regressions in linear form.

### 6.1. Change in the consumption of plastic bags

The primary objective of the legislative change was to “reduce the use of single-use plastic carrier bags, and the litter they can cause, by encouraging people to reuse bags”<sup>9</sup>. Table 5 presents the results of the difference-in-difference estimator, which indicates that the policy intervention reduced total plastic bag use by around 0.5 bags per person per trip after seven weeks of policy, down from a smaller drop (around 0.1 bags) after one week. Most importantly, the policy had a much stronger impact on the use of new plastic bags, which declined by around 1.7 plastic bags per person per trip after seven weeks, a significant drop from the 0.5 reduction in consumption one week after the policy was introduced<sup>10</sup>. Table A1 in the appendix shows that the inclusion of social preference (equation (4)) decreases the estimated impact of the legislative change, supporting the hypothesis of an indirect effect of the charge (Baron and Kenny, 1986, Zhao et al., 2010).

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9 <https://www.gov.uk/government/publications/single-use-plastic-carrier-bags-why-were-introducing-the-charge/carrier-bags-why-theres-a-5p-charge>

10 In relative terms, this drop corresponds to a 10% decline in the share of new bags in the last survey period. Notably, the reduction in total bags used might be driven by the larger size of new plastic bags currently available in the market, as well as to the larger storage capacity of reusable bags.



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**Table 5: Impact of the plastic bag charge on plastic bag consumption – Tobit regression**

	<b>Bags used – All</b>		<b>Bags used – New</b>	
	<b>Coefficient</b>	<b>S.E.</b>	<b>Coefficient</b>	<b>S.E.</b>
<b>Intercept</b>	6.7367***	0.2833	7.5591***	0.6990
<b>Treated group</b>	0.1868***	0.0485	0.4591***	0.0967
<b>Period 2</b>	-0.0340***	0.0098	-0.9721***	0.0532
<b>Policy, time 2</b>	-0.1031***	0.0209	-0.4889***	0.0205
<b>Period 3</b>	-0.0906***	0.0099	-1.7025***	0.0649
<b>Policy, time 3</b>	-0.5162***	0.0184	-1.6806***	0.0672
<b>Age</b>	-0.0341***	0.0029	-0.1071***	0.0126
<b>Male</b>	-0.4219	0.2603	0.6578	0.4930
<b>England</b>	Baseline		Baseline	
<b>Northern Ireland</b>	-0.7842***	0.1915	-1.6539	1.5472
<b>Scotland</b>	-0.5414***	0.1322	-2.1254***	0.7217
<b>Wales</b>	-0.7634***	0.1727	-2.0140***	0.1998
<b>Sigma</b>	3.2360***	0.1035	4.7323***	0.1655
<b>Income dummies</b>	Yes		Yes	
<b>Education dummies</b>	Yes		Yes	
<b>Retailer dummies</b>	Yes		Yes	
<b>Observations</b>	2704		2704	
<b>Pseudo R<sup>2</sup></b>	0.0187		0.0523	
<b>Log-likelihood</b>	-6387.20		-4786.52	

Note: residuals are clustered by period. Significance is as follows: \* = 0.10; \*\* = 0.05; \*\*\* = 0.01.

## 6.2. Internalisation of the mandatory charge

In this section, we now consider the impact of the introduction of the carrier bag charge on internal motivations. Table 6 presents the estimates of the impact of the plastic bag charge on social preferences using the difference-in-difference estimator of equation (5). The section analyses these results focusing on two main aspects of the legislative change: the internalised view on the role of the state in dealing with plastic bag use, that is the regulatory space that it should occupy (Geisinger and Stein, 2016); and social preferences that affect the motivation of the consumer to contribute to the protection of the environmental public good (Bowles and Polania-Reyes, 2012).

Table 6: Impact of the plastic bag charge on social preferences

	Control aversion		Information		Intrinsic motivation		Free-Riding		Moral engagement	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
<b>Intercept</b>	51.8345***	3.6953	60.8068***	2.5423	50.7474***	3.5548	70.0639***	4.5790	57.5085***	2.4310
<b>Treated group</b>	4.1625	1.5764	-4.2205***	0.2811	-3.2999**	0.4514	2.4737	1.6793	-3.2559**	0.3543
<b>Period 2</b>	-4.5058***	0.3624	-0.8863*	0.2771	0.9003	0.3837	-4.2076***	0.3642	-0.6791	0.2394
<b>Policy, time 2</b>	<b>-1.1249**</b>	0.2396	<b>4.8902***</b>	0.3573	<b>1.9385*</b>	0.4715	<b>1.4318*</b>	0.4137	3.8656***	0.3000
<b>Period 3</b>	0.6467	0.4385	-4.6855***	0.1156	-0.1183	0.1826	-1.6267**	0.3290	-1.5049**	0.3145
<b>Policy, time 3</b>	<b>-6.6851***</b>	0.2493	<b>4.6112***</b>	0.1838	<b>1.4126**</b>	0.2956	<b>-4.0491**</b>	0.4226	2.7825**	0.3344
<b>Age</b>	-0.0811*	0.0209	0.1460**	0.0222	0.2496**	0.0373	-0.0012	0.0357	0.2029**	0.0252
<b>Male</b>	0.5353	0.3979	-2.8051	1.0889	-4.1977*	1.0080	-2.1356*	0.6870	-3.6170**	0.5849
<b>England</b>	Baseline		Baseline		Baseline		Baseline		Baseline	
<b>Northern Ireland</b>	-11.2902	5.1570	4.7572*	1.4603	6.6748	3.6127	-1.8025	4.1799	7.6470**	1.4892
<b>Scotland</b>	-8.7500	4.3285	-1.1668	2.1487	2.7410	1.2506	-4.1099	2.8891	5.3522	2.7872
<b>Wales</b>	-9.6300	3.3188	-0.5367	3.2079	3.6311**	0.4613	-3.0269	3.2062	3.0098	1.1710
<b>Income dummies</b>	Yes		Yes		Yes		Yes		Yes	
<b>Education dummies</b>	Yes		Yes		Yes		Yes		Yes	
<b>Retailer dummies</b>	Yes		Yes		Yes		Yes		Yes	
<b>Observations</b>	2,704		2,704		2,704		2,704		2,704	
<b>Log-likelihood</b>	-13,265.01		-12,582.43		-12,793.79		-12,156.82		-12,604.62	
<b>R<sup>2</sup></b>	0.0530		0.0381		0.0484		0.0370		0.0418	

Note: residuals are clustered by period. Significance is as follows: \* = 0.10; \*\* = 0.05; \*\*\* = 0.01.

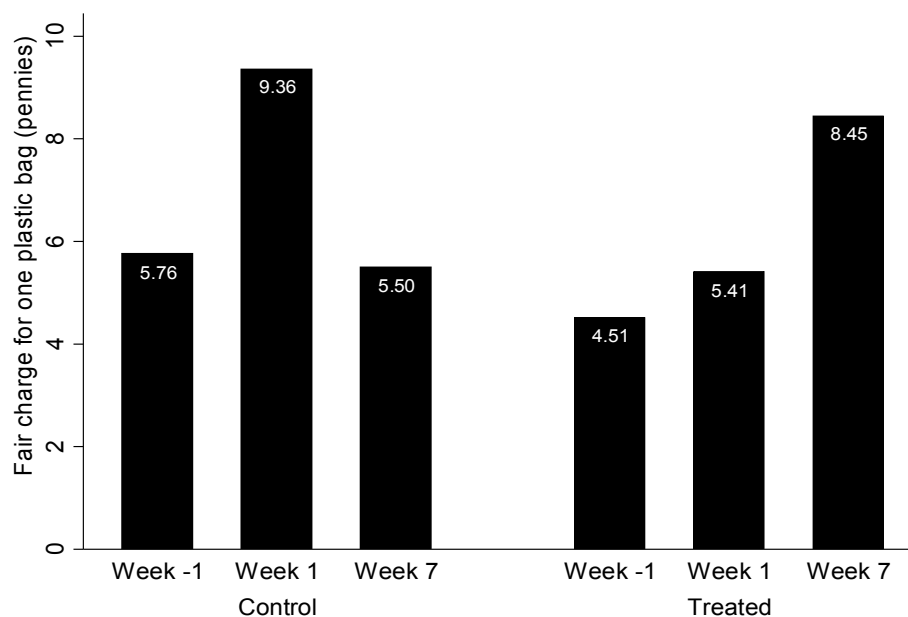
### 6.2.1. Attitudes toward the regulatory space

Table 6 shows that the overall decline in the consumption of new plastic bags is accompanied by changes in the way consumers view the role of government in guiding consumer behaviour. In particular, control aversion immediately declines once the policy is introduced, with a successive very large drop 7 weeks after the legislative change. As a result, consumers increasingly believe that the government correctly intervened in the market by forcing retailers to charge their customers for the new plastic bags they used. The support for the policy can be also observed in Figure 5, which shows the movement in

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the “fair” plastic bag charge from the perspective consumers: the average fair charge increased steadily in consumers initially unexposed to the policy, while the control group shows no significant change after 7 weeks despite a temporary initial peak<sup>11</sup>.

**Figure 5: Fair charge for a plastic bag over time**



Note: figures refer to averages. Using a one-tailed t-test, differences between period 1 and the two post-policy periods are significant at 4% (period 2) and 6% (period 3) for treated, and insignificant (period 2) and significant at 9% (period 3) for controls. Kruskal-Wallis rank test for treated:  $\chi^2 = 12.330$  ( $p = 0.0021$ ). Kruskal-Wallis rank test for control:  $\chi^2 = 7.117$  ( $p = 0.0285$ ).

Importantly, consumers used the plastic bag charge to obtain information on the underlying motive of the government: consumers increasingly view plastic bags as a social problem that needs to be addressed, with a rapid increase in perception of the problem that remained stable after seven weeks<sup>12</sup>. Finally, the introduction of a mandatory charge changed the view of a potential free-riding problem, suggesting that consumers

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11 The introduction of the charge also led to a persistent increase in willingness to contribute monetarily to this regulation only in those shoppers who were initially unexposed to the policy (Figure 5). While average fair charges changed significantly, median values for the control groups remained constant over the three periods at £0.05, while for the treated the fair charge went from £0.02 in week 1 to £0.05 in both week 2 and 3.

increasingly considered plastic bag use as a collective action problem: the charge initially increased the view that “other” customers would continue using plastic carrier bags, but this coefficient reversed sign and grew in absolute magnitude after seven weeks.

### **6.2.2. Changes in motivation**

Apart from observing the perceived role of government, Table 6 shows that the plastic bag charge had a significant impact on internalised values concerning plastic bags consumption. In particular, intrinsic motivation (the belief that plastic bags reuse is “right”, independently on costs and benefits of doing it) increased after the mandatory charge was introduced, and remained significant after seven weeks, albeit declining slightly. The legislative change also successfully increased the moral engagement of the consumers, who increasingly viewed plastic bag reduction as a moral obligation; however, following a sharp increase after one week, moral engagement declined slightly after seven weeks, but remained significantly positive. As a result, the legislative change altered the underlying values of the consumer, although in both instances the initial response wears out (mildly) over time, possibly reaching a stabilisation point as consumers learn about their preferences.

## **6.3. The instructional impact of the legal change**

The results so far show that the legislative intervention successfully changed behaviour. However, the period-specific fixed effects in the previous sections also indicate that the policy did not only change the motivational basis of the target population, but also of those consumers who were not targeted by the policy. This suggests that the control population might have reacted to the intervention that was targeted toward individuals that were not yet paying for their plastic bags. This remains a possibility as the control group may have also been influenced by the instructive significance of the legislative change itself and/or increased media attention that highlighted the negative environmental consequences of plastic bags. The difference between the instructional effect of the legislative change (the simple announcement of the need for a change in behaviour by authority) and the full legal change (the legal change with a sanction attached) can be determined by observing M&S customers: in England, these customers were already

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12 See also <http://www.telegraph.co.uk/news/earth/environment/12034574/Plastic-bag-5p-charge-cuts-usage-by-almost-80-per-cent-first-data-shows.html>.

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Table 7: Estimated coefficients of a DID regression on M&S customers only

	Bags used		Bags used		Intrinsic		Control		Information		Free-riding		Moral	
	Coefficient	S.E.	- All	- New	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
<b>Intercept</b>	6.9936***	0.1737	6.1941***	1.0094	54.0165**	7.8955	37.3514	16.1568	60.7302***	5.9084	65.6329***	2.3291	62.6751***	2.8687
<b>Treated group</b>	0.5096***	0.0329	3.5090***	0.1241	-11.3843***	0.4325	20.4846***	0.5202	-4.5976**	0.5078	9.7009***	0.1172	-12.6964***	0.3777
<b>Period 2</b>	-0.5803***	0.0772	0.6731***	0.0654	-4.5837***	0.3619	6.8156**	0.7490	-1.1538	0.7917	4.8006**	0.7235	-6.7530***	0.3754
<b>Policy, time 2</b>	<b>0.6483***</b>	<b>0.0948</b>	<b>-2.1103***</b>	<b>0.1711</b>	<b>7.0681***</b>	<b>0.2598</b>	<b>-15.0646***</b>	<b>0.6468</b>	<b>-0.2614</b>	<b>0.7826</b>	<b>-11.7914***</b>	<b>0.3748</b>	<b>7.5016***</b>	<b>0.0843</b>
<b>Period 3</b>	0.1822***	0.0610	1.1576***	0.0856	1.2428	0.4392	7.0481**	0.8622	-7.4992***	0.3978	8.2462***	0.4197	-6.7900**	0.7642
<b>Policy, time 3</b>	<b>-0.2691***</b>	<b>0.0572</b>	<b>-3.2227***</b>	<b>0.1428</b>	<b>-0.1571</b>	<b>0.3733</b>	<b>-10.3906***</b>	<b>0.9715</b>	<b>3.6763***</b>	<b>0.3378</b>	<b>-12.7949***</b>	<b>0.2526</b>	<b>7.7279***</b>	<b>0.7309</b>
<b>Age</b>	-0.0422***	0.0024	-0.1096***	0.0165	0.2554	0.1017	-0.1448	0.1003	0.1893	0.0818	0.0398*	0.0112	0.1801*	0.0575
<b>Male</b>	0.0219	0.1441	0.8040*	0.4305	-4.5894*	1.2121	0.7824	1.0585	-2.8159*	0.9100	-2.6097	0.9623	-3.9901*	1.2861
<b>Income dummies</b>	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
<b>Education dummies</b>	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
<b>Sigma</b>	2.9606***	0.1186	4.0239***	0.3639										
<b>Observations</b>	877		877		877		877		877		877		877	
<b>Log pseudolikelihood</b>	-2027.06		-1513.70											
<b>Pseudo R2</b>	0.02		0.06		0.05		0.05		0.04		0.04		0.05	
<b>Root MSE</b>			27.37		33.45		33.45		24.41		21.53		25.45	

Note: residuals are clustered by period. Significance is as follows: \* = 0.10; \*\* = 0.05; \*\*\* = 0.01.

paying for plastic bags, so that the sanction remained unchanged; while in the rest of the UK consumers experienced no change in policy.

Table 7 reports the results of the DID estimator on M&S customers only, where the control group refers to consumers outside England. Results indicate that a significant part of the change in behaviour and attitudes is driven by the instructive power of the legal change, and not by the charge in itself. Specifically, the pure presence of the policy caused a drop in consumption of plastic bags (new in both periods, and in total after seven weeks), a reduction in perceived free-riding and control aversion, and an increase in moral engagement. Notably, the policy caused no change in intrinsic motivation after seven weeks, despite a temporary increase in the immediacy of the change; while information on the need for the policy change only increased significantly after seven weeks. While these results do highlight the pure instructive effect of the legislative intervention, some caution needs to be taken in interpreting the results: these consumers were already exposed to a financial penalty, but only 2 in this sample shopped exclusively at M&S before the charge was introduced.

#### **6.4. Direct and indirect effect of the legislative change**

It was shown above that the mandatory charge induced a reduction in plastic bag use, as well as changing the internalised attitudes and motivations of consumers, supporting the dual effect proposed in Figure 1. This section makes a comparative assessment of these effects, to determine whether the policy impacts behaviour primarily through price or motivation.

Table 8 indicates that the direct (i.e. price) effect of the charge on plastic bags use is much larger than its indirect (i.e. motivational) effect. The full list of estimated direct effects from equation (4) can be found in table A1 in appendix B. Specifically, one week after the charge was introduced, the total indirect effect of the policy accounted for a reduction of around 0.15 new plastic bags per person per trip, against a direct reduction of 0.34 new bags, so that price accounted for 69% of the total reduction. Seven weeks after the policy was introduced, the indirect effect of the policy increased slightly in absolute value, causing a reduction of 0.19 new plastic bags per person per trip, against a direct reduction of around 1.5 new bags, so that price represents 89% of the reduction. This suggests that the price effect grew much faster than motivational effect over time. Importantly, after seven weeks the largest motivational contribution to compliance comes from a reduction in control aversion; and a reduction in the concerns of free-riders results in a small increase in the amount of new plastic bags used in the marketplace.

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Table 8: Comparison between direct and indirect effect of the policy on behaviour

			ALL BAGS		NEW BAGS		
		Period	Effect	S.E.	Effect	S.E.	
<b>Direct effect of policy</b>		1	-0.0511**	0.0238	-0.3382***	0.0325	
		2	-0.4524***	0.0504	-1.5111***	0.1139	
<b>Indirect effect via</b>	<b>Intrinsic motivation</b>	1	-0.0108	0.0124	-0.0425**	0.0177	
		2	-0.0079	0.0090	-0.0310**	0.0123	
	<b>Control aversion</b>	1	-0.0093**	0.0037	-0.0240***	0.0068	
		2	-0.0554***	0.0184	-0.1428***	0.0272	
	<b>Information</b>	1	-0.0285	0.0213	-0.0552*	0.0284	
		2	-0.0268	0.0200	-0.0520*	0.0266	
	<b>Free Riding</b>	1	-0.0083***	0.0028	-0.0169***	0.0052	
		2	0.0236***	0.0045	0.0479***	0.0068	
	<b>Moral engagement</b>	1	0.0062	0.0064	-0.0120**	0.0060	
		2	0.0045	0.0046	-0.0087**	0.0044	
	<b>Total Indirect effects</b>		1	-0.0507*	0.0259	-0.1507***	0.0350
			2	-0.0620**	0.0294	-0.1867***	0.0408
	<b>Total effects</b>			-0.1018***	0.0352	-0.4889***	0.0478
				-0.5145***	0.0583	-1.6977***	0.1210

Significance is as follows: \* = 0.10; \*\* = 0.05; \*\*\* = 0.01.

## 7. ROBUSTNESS TESTS

The DID results presented in the previous section estimated the impact of the legislative change on a group of consumers not exposed to the charge relative to a reference group who were already paying the charge on environmental grounds. The choice of reference group might influence the results observed in this analysis: in a DID analysis, the impact of a policy on a target population is estimated relative to a control population of individuals unexposed to the policy. In particular, there may be a fundamental problem of self-selection whereby the treatment allocation is not truly random (given  $X$  and  $D$ ). This potential self-selection entails that environmentally-friendly consumers belong to one of the two groups before the legislative change occurs (Keele et al., 2015). This point is unlikely to characterise the choice between Scotland, Northern Ireland, or Wales, given the common environmental policies. However, it is possible that M&S's policy over plastic bags attracted a number of environmentally-conscious customers (see e.g. Disney et al.,

2013). However, only two respondents shopped exclusively in M&S before the charge was introduced, and the number and type of attitudinal controls used in the analysis could be sufficient to address the problem. In this section we run a series of robustness checks to test the validity of the results that have been presented.

Specifically, the robustness checks entail repeating the analyses above for four alternative control groups. The first alternative is to observe change in England only (where the new policy was introduced), removing Scotland, Northern Ireland, and Wales; in this case, the control group refers only to shoppers in M&S, who were already being charged for plastic bags for environmental reasons. The second option is to remove individuals who shopped in M&S from the analysis altogether, comparing inter-country differences as a purely natural experiment; using this control group would remove the potential self-selection of environmentally motivated shoppers who may prefer M&S because of their interest in the reduction of plastic bags waste. A third option is identical to the control of the main analysis, but also includes shoppers in Lidl and Aldi, as their customers were also paying for plastic bags before the policy was introduced, although not on environmental grounds (and profits were not donated to a good cause). The last option removes M&S customers from the control group, whilst keeping them in the sample.

Table 9 presents the DID estimates using the different control groups. The impact of the plastic bag charge did not vary qualitatively, albeit some coefficients do differ noticeably in size. The consumption of new plastic bags decreased with the same trend regardless of the control group used. However, when considering England alone, the charge resulted in an increase in new plastic bags used after one week, a result suggesting that at this point plastic bags use by English M&S customers declined faster than other shoppers. Intrinsic motivations and moral engagement increased in all samples, although these changes remained significant only when M&S consumers were either omitted or not included in the control. Free riding aversion presented less stable results one week after the introduction of the charge, but this variable dropped after seven weeks in all versions. Finally, the impact of the charge on control aversion and on information on the intention of the government did not vary significantly, with control aversion declining (except when considering England alone in period 2) and information increasing in all scenarios. These results indicate that removing other UK countries from the control would have lost significant information relevant for the DID estimator; while removing M&S customers from the control or from the sample would have caused similar but larger estimated effects than otherwise. In summary, the control used in the result section seems to provide realistic estimates, and the key conclusions are robust to various potential definitions of the treatment group.



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**Table 9: Robustness checks for the difference-in-difference estimator**

	Policy	Initial results		Only England		No M&S		Incl. Lidl & Aldi		M&S not in control	
		Period	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient
<b>New bags</b>	2	-0.4889***	0.0205	0.1927***	0.0675	-1.4313***	0.1096	-0.4327***	0.0208	-1.9204***	0.1422
	3	-1.6806***	0.0672	-0.9592***	0.0571	-2.2725***	0.1332	-1.5901***	0.1053	-2.7369***	0.0861
<b>Intrinsic motivation</b>	2	1.9385*	0.4715	0.7245	0.5807	0.5952	0.3671	0.6742	0.4266	3.6744***	0.2292
	3	1.4126**	0.2956	0.1241	0.2897	3.7048***	0.5886	0.7595	0.6567	3.4110***	0.2141
<b>Control aversion</b>	2	-1.1249**	0.2396	3.1111***	0.2913	-4.5759**	0.6886	-0.6506	0.3477	-9.2582***	0.0959
	3	-6.6851***	0.2493	-2.7340***	0.2213	-12.6123***	0.6713	-5.1179***	0.7343	-12.2863***	0.4058
<b>Moral engagement</b>	2	3.8656***	0.3000	2.6306**	0.4869	2.6093**	0.4888	1.8281**	0.2484	4.9631***	0.1932
	3	2.7825**	0.3344	0.3142	0.4274	5.1677**	0.5961	1.3421	0.6139	6.6240***	0.3007
<b>Information</b>	2	4.8902***	0.3573	6.0493**	0.6678	0.8882	0.3925	2.3384***	0.2368	1.2990**	0.1461
	3	4.6112***	0.1838	3.8163**	0.5280	3.8536*	0.9008	3.6199***	0.3505	4.6714***	0.1403
<b>Free Riding</b>	2	1.4318*	0.4137	4.5929***	0.2073	-1.3000	0.5144	-1.3692*	0.3866	-5.1117***	0.3887
	3	-4.0491**	0.4226	-0.9458	0.4073	-6.3554***	0.7910	-4.9482***	0.3440	-8.9368***	0.6543
<b>Observations</b>		2,704		2,265		1,827		2,704		2,704	

Significance is as follows: \* = 0.10; \*\* = 0.05; \*\*\* = 0.01. Note: for the “New bags” equation, results refer to the regression without attitudinal variables.

## 8. DISCUSSION

We have aimed to measure the motivational and behavioural impact of a legislative intervention over time (i.e. the introduction of a mandatory plastic bag charge on English consumers). The policy was introduced in England in October 2015, and an identical policy was already in place in all other parts of the UK. Similarly, one retailer was voluntarily charging for plastic bags on environmental grounds throughout the UK prior to the time that the policy was introduced in England. This setting provides an ideal context to estimate the impact of a policy intervention. Our results indicate that the legislative change had a mild impact on *total* plastic bags use, but a much stronger effect on the use of *new* plastic bags<sup>13</sup>. Indeed, new plastic bag consumption fell dramatically and broadly in

13 This finding somewhat conflicts with earlier evidence, which showed a spillover effect that decreased total consumption of plastic bags once the charge was introduced in M&S (Disney et al., 2013): while the total

line with other countries that implemented similar charges, both within the UK and further abroad (e.g. Convery et al., 2007). In this sense the legislative reform has achieved its aim.

More importantly, this study sheds light on how the mandatory charge backed by legislative fiat was internalised by consumers over the period of its introduction. We find that the charge has fundamentally changed the way a significant proportion of consumers perceive their use of plastic bags. Our results support evidence of an internalisation process, whereby consumers took on the rationale for the legislative change once it was introduced, and supported the legislator in increasing the regulatory space within which it operates. That is, a significant portion of English consumers do seem to use legal change as a guide for conduct and the determination of rightful behaviour as hypothesised by Hart (1997). This finding is important: as pointed out by Bilz and Nadler (2014), legislative change does not always lead to the internalisation of the values the legislation aims to promote<sup>14</sup>. Indeed, it is well known that negative reactions to legal change can occur, leading to reduced compliance (Carbonara et al., 2012, Acemoglu and Jackson, 2014). In this sense our results also provide empirical support for the expressive function of the law as advanced by legal scholars such as Cooter (1998), McAdams (1997), and Sunstein (1996).

While the results point to multiple mechanisms behind increased internal motivation (with movements in measures for control aversion, information, intrinsic motivation, free-riding, and moral engagement all being significant), it is noteworthy that concerns over free riding first rose and then fell (significantly in magnitude) over time. This suggests that the legislative intervention may have initially highlighted the need for collective action and then led to increased returns of adopting the new norm of reducing new plastic bag use. In terms of direction for future research, it would be worthwhile investigating whether these results hold in societies where the state does not enjoy the same level of authority as it does in England (for instance, societies subject to a legal transplant and/or where it generates widespread mistrust).

Another important result concerns how the intervention seemed to generate responses from both the control and treatment groups. The legislative change was accompanied by a period where consumers ‘naturally’ decreased their consumption of

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reduction in use of plastic bags is in line with the results presented here, the spillover effect is fairly small, and might be smaller if it accounts for the larger size of new bags after the policy, because by default they would reduce the need for bags.

14 For instance, while they highlight the close relationship between legislative change and tobacco smoking, the same relationship does not hold for gun control (despite various legislative changes across U.S. states).

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plastic bags: a significant fixed survey effect indicated a drop in plastic bags in the whole sample. This result points to the instructional effect generated by the mere informational content of the legal change; consumers made aware of the policy were impacted whether within under control or not. This could be generated by the ability of the state and/or media organisations to shape public opinion purely through the delivery of information. However, it must be remembered that the change in behaviour is largely explained by the change in the price on the controlled behaviour (rather than the intrinsic motivation reported by respondents). As a result, although behaviour moves in response to legal change, it appears to be calibrated to quantitative sanctions.

Another important finding is the temporal aspect of the internalisation process. The results indicate that consumers internalised the legislative change immediately, i.e. one week after its introduction. However, while internalisation of the regulatory space occupied by government increased over time, the motivational and moral views of plastic bags reuse decreased after seven weeks compared to the first week, albeit remaining strongly significant. In other words, the introduction of legislative change led to increasing support for the role of the government over time, while attitudes towards plastic bag use showed an overly optimistic pattern, with a large jump when the policy is introduced that settled back down as time passed. These results highlight the complexity of the internalisation process and how some aspects of internalisation (and crowding more generally) seem to be short lived.<sup>15</sup>

In addition to shedding light on the internalisation process, this analysis also contributes to the crowding literature more broadly. While there have been numerous empirical studies undertaken, as noted by Rode et al. (2015), many suffer from severe methodological problems, especially in accurately measuring the base case of internalised motivation and separating the effect of the policy from other factors. We consider that our methodological approach deals with many of shortcomings that have been identified. Specifically, our approach uses econometric methods that allow for the identification of causal effect, and explore changes in the attitudinal basis of consumption along with changes in behaviour. Finally, rather than focusing only on the short term impact of the policy, the analysis also attempts to explain the longer-term dynamics of the policy (as in

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15 This is consistent with previous findings (Goeschl and Perino, 2012), which found the crowding out effects of an emissions tax (in a laboratory setting) to be only temporary. These results seem to indicate that the longevity (and temporal aspects) of internalised motivations would seem to be a fruitful area of future research.

Dolan et al., 2015), to determine whether and why changes in behaviour are short-lived or sustained over time. We also provide a rare case of crowding in, especially when a charge has been imposed to deter behaviour<sup>16</sup>.

In sum, we find that the response to legal intervention is both a matter of direction and scale. The legislative intervention provides a signal on the direction in which society should move, and many of the consumers in our study took action to move in the indicated direction. This change was relatively immediate, and then continued throughout the survey period. Most of the impact of the policy was driven by the change in price, not the change in internal motivation. Furthermore, we also found that the price effect grew faster over time than the internal motivation effect, so that the relative (percent) contribution of motivation to the change in behaviour decreased after seven weeks. These results suggest that while the internal motivation effect of the charge is real, it is subsidiary to the price effect and this grows over time. As such, this suggests that while policy makers should be conscious of potential crowding in and crowding out effects, they should primarily focus on getting the price right.

## 9. CONCLUSION

This paper has estimated the short term behavioural effects of the introduction of a law in England that requires supermarkets to charge for the new plastic bags they provide to their customers. This has enabled us to estimate the price effect and internalised motivation effect. Using primary data and a difference-in-difference estimator, we find that the charge reduced new plastic bags use by 1.7 bags per shop after 7 weeks. This change in behaviour was driven by both a pure price effect and changes in internalised motivations. In particular, we found that the mandatory charge made consumers more accepting of the government's role in regulating plastic bag use, and increased intrinsic and moral motivation in reducing plastic bag use. We also found that the price effect is considerably stronger than the crowding in effect (by a factor of 10). Furthermore, while both effects were shown to grow over time, in relative terms, the role of price increased while the motivational component decreased over time.

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16 As found by Rode et. al. (2015), such charges are normally associated with crowding out effects generated by control aversion, frustration, reduced warm glow, reduced image motivation, release from moral responsibility and frame shifting.

## APPENDIX A: QUESTIONNAIRE

### Demographics

- 1) Where do you live in the UK? (England; Northern Ireland; Scotland; Wales)
- 2) What is your age?
- 3) What is your yearly income (before taxes)? (Below £ 15,000; £ 15,000-£ 20,000; £ 20,001-£ 30,000; £ 30,001-£ 40,000; £ 40,001-£ 50,000; £ 60,001-£ 60,000; £ 50,001-£ 70,000; Above £ 70,000; I prefer not to say)
- 4) What gender do you identify with? (Male; Female)
- 5) What is the highest level of education you have attained? (Basic education; Secondary education; University degree – undergraduate level (e.g. BSc, BA); University degree – Master level or equivalent (e.g. MSc, MA, MRes); University degree – Doctoral level (PhD); Other - please specify)

### Behavioural questions

- 6) In which of the following retailers have you been grocery shopping in the last month (choose as many as you need)? (Asda; Aldi; Co-operative; Iceland; Marks & Spencer; Morrisons; Lidl; Sainsbury's; Tesco; Waitrose; Small local retailer; Other – please specify)
- 7) Think about the last time you used carrier bags in your grocery shopping trip (these can be your own bags, as well as new ones from the store). How many bags did you use? (if above 15, please indicate 15)
- 8) Of the bags you used, how many new carrier bags did you get from the store? (if above 15, please indicate 15)
- 9) Do you think it is right for the government to make retailers charge customers for plastic carrier bags? (Yes; No)
- 10) What do you think a fair charge for plastic carrier bag should be (in pence)?

### Attitudes

On a 100-point scale (0 = “I strongly disagree”; 100 = “I strongly agree”), what is your level of agreement with the following statement? (randomised order)

- 11) Minimising the number of plastic carrier bags when I shop for groceries is important to me, regardless of any benefit or inconvenience that may result.
- 12) I feel good when I don't use new plastic carrier bags when I shop for groceries because it helps the environment.
- 13) Charging for carrier bags and giving the profits to a good cause (e.g. donating to a charity) will ensure that plastic carrier bag use is no longer a problem for our society.
- 14) The government should not interfere by requiring retailers to charge for plastic carrier bags.
- 15) Plastic carrier bags are currently overused.
- 16) Other customers will continue using plastic carrier bags even if I stop using them.
- 17) Shoppers have a moral obligation to minimise the use of plastic carrier bags.

### Complementary/Substitute behaviours

- 18) Thinking about the past 7 days, how much money did you donate to a good cause, in pounds? (e.g. donating to a charity)
- 19) Thinking about today, did you have a reusable carrier bag with you? (Yes; No)
- 20) Thinking about your last grocery shopping trip, did you buy any long-life/reusable bags? (Yes; No)
- 21) Finally, thinking about your last grocery shopping trip again, did you buy plastic bin liners? (Yes; No)

## APPENDIX B: MAIN EQUATION OF THE MEDIATION ANALYSIS

Table A1: Impact of the plastic bag charge on plastic bag consumption – equation (4)

	<b>Bags used – All</b>		<b>Bags used – New</b>	
<b>Intercept</b>	7.2524***	0.3153	9.2980***	0.5899
<b>Treated group</b>	0.1312**	0.0633	0.2590***	0.0846
<b>Period 2</b>	-0.0206*	0.0123	-0.9128***	0.0855
<b>Policy, time 2</b>	-0.0511**	0.0238	-0.3382***	0.0325
<b>Period 3</b>	-0.1283***	0.0271	-1.7465***	0.0711
<b>Policy, time 3</b>	-0.4524***	0.0504	-1.5111***	0.1139
<b>Age</b>	-0.0315***	0.0034	-0.0986***	0.0123
<b>Male</b>	-0.4736*	0.2546	0.4741	0.4670
<b>England</b>	Baseline		Baseline	
<b>Northern Ireland</b>	-0.6376**	0.2555	-1.1964	1.4084
<b>Scotland</b>	-0.4941***	0.1732	-1.9598***	0.7145
<b>Wales</b>	-0.6829***	0.1418	-1.7560***	0.1625
<b>Control aversion</b>	0.0083***	0.0027	0.0214***	0.0040
<b>Intrinsic motivation</b>	-0.0056	0.0063	-0.0219***	0.0074
<b>Moral engagement</b>	0.0016	0.0016	-0.0031**	0.0015
<b>Information</b>	-0.0058	0.0043	-0.0113**	0.0057
<b>Free Riding</b>	-0.0058***	0.0009	-0.0118***	0.0012
<b>Sigma</b>	3.2082***	0.0913	4.5524***	0.2077
<b>Income dummies</b>	Yes		Yes	
<b>Education dummies</b>	Yes		Yes	
<b>Retailer dummies</b>	Yes		Yes	
<b>Observations</b>	2,704		2,704	
<b>Pseudo R<sup>2</sup></b>	0.0223		0.0694	
<b>Log-likelihood</b>	-6363.72		-4700.20	

Note: residuals are clustered by period. Significance is as follows: \* = 0.10; \*\* = 0.05; \*\*\* = 0.01.

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