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CROWDING-IN, CROWDING-OUT AND OVER-CROWDING

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Abstract

We conduct a field experiment involving real purchasing decisions in a large supermarket chain to test the effect of different regulatory interventions aiming to induce a more climate-friendly diet on intrinsic motivation. Focusing on shoppers who prefer the dirty variety, we compare labeling, a subsidy, a product ban and neutrally framed versions of the latter two in their ability to induce shoppers to switch to cleaner varieties. Carbon footprint labels and bans activate intrinsic motivation of shoppers (crowding-in). Remarkably, a subsidy framed as an explicit intervention is less effective than both a label and an equivalent but neutrally framed price change. The effects of information and changes in relative prices are not only not additive (crowding-out) but combined perform worse than each individually (over-crowding). We therefore find markedly different effects of price and quantity based instruments on intrinsic motivation.

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1. Introduction

Intrinsic motivation to contribute to public goods is an empirically highly relevant factor driving a substantial proportion of charitable giving, volunteering, nonprofit organizations[4] and environmentally friendly consumption. A fast growing body of literature points out that economic incentives and more generally regulatory interventions aiming to improve the provision of public goods interact with individuals' intrinsic motivation (for surveys see Bowles, 2008; Frey and Jegen, 2001).

Using actual food purchases of some nine hundred customers of a leading UK supermarket we compare the impact of price and quantity based instruments on the intrinsic motivation of consumers to contribute to climate change mitigation. Food production significantly contributes to the emission of greenhouse gases (GHG) and diet choices are therefore an important determinant of a household's carbon footprint (Carlsson-Kanyama and Gonzales, 2009; Eshel and Martin, 2006; Weber and Matthews, 2008). However, relatively little work has so far been done on how to induce consumers to switch to less GHG intensive diets. The non-point source character of most agricultural emissions make downstream regulation, ceteris paribus, more attractive compared e.g. to industries included in the European Union's Emission Trading System. However, when regulation directly targets consumers, the instrument chosen might interact with an individual's intrinsic motivation both positively (crowding-in) or negatively (crowding-out).

While evidence of crowding-in is sparse (Charness and Gneezy, 2009), crowding-out has been observed in many settings and for a number of different interventions. The introduction of monetary rewards for a previously unpaid task is likely to reduce effort levels (Heyman and Ariely, 2004; Ariely et al., 2009; Leuven et al., 2010) unless compensation is substantial (Gneezy and Rustichini, 2000b). Similar negative effects of introducing compensation have been found in people's willingness to accept a potentially hazardous facility in their neighborhood (Frey and Oberholzer-Gee, 1997) and for blood and charitable

[4] See e.g. Reinikka and Svensson (2010)

donations (Meier, 2007; Mellström and Johannesson, 2008). Fines (Fehr et al., 2007, Gneezy and Rustichini, 2000a), competitive tenders (Reeson and Tisdell, 2010) and restrictions of the choice set (Falk and Kosfeld, 2006) can also result in a reduction of intrinsic motivation.

A number of different theories have been put forward that seek to explain this interaction between changes in the incentive structure and the level of intrinsic motivation. One set of approaches is based on asymmetric information either between a principal and an agent (Benabou and Tirole, 2003; Sliwka, 2007; Ellingsen and Johannesson, 2008) or between peers where voluntary contribution serve as a signaling device of a person's type (Benabou and Tirole, 2006). A different approach emphasises affective rather than cognitive drivers of human behavior and the perception of who is in control (Frey, 1997).

The present paper fills a gap in this literature by studying how price and quantity based regulatory interventions interact with intrinsic motivation in food purchasing decisions and hence ultimately affect people's diets in a field experiment. The contributions are threefold:

Firstly, while there are papers that use environmentally motivated purchasing decisions for motivation and policy recommendations (e.g. Ariely et al., 2009) we are not aware of any study that actually considers motivation crowding in real purchasing decisions. This is relevant since it implies that all choices are made in a market context. Hence, crowding effects are not brought about by moving from the realm of non-market choices to market transactions. Regulatory interventions only highlight or price a certain characteristic of an already priced product.

Secondly, we compare different regulatory interventions instead of comparing one instrument with a no-intervention baseline (as e.g. in Ariely et al., 2009; Meier, 2007). Based on a differences-in-differences analysis we can therefore draw conclusions on their relative performance in terms of motivation crowding. This is an important contribution to the academic and policy debate on instrument choice and on the 'prices versus quantities' controversy in particular. The latter has so far mainly focused on uncertainty (Weitzman, 1974), enforcement (Montero, 2002) and innovation (Requate and Unold, 2003) but

largely ignored interactions with intrinsic motivation. A notable exception is Goeschl and Perino (2009) who pursue closely related questions in the context of carbon offsets.

Thirdly, we are able to separate motivation crowding from non-interventionist changes in relative prices (Goeschl and Perino, 2009) and the choice set (Falk and Kosfeld, 2006). This highlights the relevance of how changes in the choice situation are perceived by those affected. It establishes a close link between the literature on motivation crowding and that on framing effects (Tversky and Kahneman 1981).

We compare three explicit regulatory interventions, a carbon footprint label, a subsidy for cleaner varieties and a ban of dirty varieties, which allow consumers to rank product varieties according to their GHG emissions. The former only conveys information while the latter two impose monetary rewards and a restriction of the choice set, respectively. To disentangle the effects of a fundamental change in the choice situation from the interventionist character of a subsidy and a ban, we also have neutrally framed versions of these instruments.

Both a label and a product ban activate intrinsic motivation. Focusing on consumers that prefer dirty varieties, labeling induces a significant share of them to switch to clean varieties. Likewise, an explicit ban results in less consumers opting-out than if subject to a neutrally framed removal of products. Both instruments therefore increase the relevance of intrinsic motivation in consumers' decision making (crowding-in).

A subsidy induces less switching to clean varieties than a label and a neutrally framed but otherwise equivalent price change. The former implies that norm activation and the response to a relative price changes are sub-additive if combined (crowding-out). The latter is an even starker - and to the best of our knowledge new - result since a subsidy that provides the relevant information to activate intrinsic motivation results in an outcome that is worse than if intrinsic motivation is absent altogether. A subsidy activates intrinsic de-motivation.

Combing a monetary reward with information provision performs worse than each of them separately (over-crowding).

The remainder of the paper is structured as follows. The next section describes the experiment and provides a simple model of consumption choices in the presence of intrinsic motivation deriving testable hypotheses on the effect of different regulatory interventions. Section 3 presents results. The last section discusses the policy implications of our findings and concludes.

2. The Experimental Setup

Experimental Procedures

The experiment was conducted in seven Sainsbury's supermarket[5] stores in the Greater London area[6] in February and March 2010.

Shoppers were approached when they entered the supermarket. They were asked if they intend to purchase the dirty variety of any of the included product categories (see Table 1). This was done without any reference to 'dirty' but merely by a description of the variety (e.g. six-packs of Cola). If a shopper was interested in buying at least an item from one of the categories, she was invited to participate in the experiment and could opt for any combination of the four product categories. Nevertheless, participants were then presented with a range of dirty and clean varieties in each product category they selected. Those that chose a clean variety initially are excluded from the analysis. Participants were seated in front of a laptop computer and are presented with a range of varieties (both 'dirty' and 'clean') within their chosen product categories.

Table 1: Structure of the Choice Set in the Experiment

Product	Choice set
Cola (2 liters)	Cans (relatively "dirty" option): Coca Cola, Pepsi Cola, Diet Coke, Diet Pepsi, Coke Zero, and Pepsi Max; Plastic bottle (relatively "clean" option): Coca Cola, Pepsi Cola, Diet Coke, Diet Pepsi, Coke Zero, and Pepsi Max.
Milk (2-pint)	Whole milk (highest carbon footprint); semi-skimmed milk (intermediate carbon footprint); skimmed milk (lowest carbon footprint).
Meat (various weights)	Beef products (relatively "dirty" option): minced meat, casserole steak, and braising steak; Chicken products (relatively "clean" option): chicken breast, mini chicken fillet, and drumsticks.

[5] This retailer chain accounts for around 27% of the total market share in the study area (Information available on http://www.j-sainsbury.co.uk/index.asp?pageid=451), and 16% in all the UK. Sainsbury's also has a well developed internet shopping facility that reaches 88% of the total UK population, with over £ 500 millions worth of sales in 2009 (Information available on http://www.j-sainsbury.co.uk/files/reports/ar2009_report.pdf, page 5. This value only includes food and grocery products, as the non-food area has been launched in 2010).

[6] The stores were located Walthamstow, New Barnet, Edgware, Chiswick, Merton, and Lewisham. Each store was surveyed for 8 hours a day for 2 days, with the exception of Edgware, where the experiment lasted 4 days.

Butter/margarine (500g)	Butter (relatively "dirty" option): Lurpak, Anchor, Countrylife, Kerrygold, Sainsbury's own brand; Margarine (relatively "clean" option); Lurpak, Anchor, Flora, Clover, Sainsbury's own brand.

Participants saw pictures of the products and their current in-store prices. Each participant made two choices in each of the product categories chosen. The first choice constitutes their baseline. Next participants were given the possibility to obtain more information on environmental and nutritional matters associated with food labels. It explained the information provided on food labels. Participants with no interests in any of these two options were able to go directly to the second choice.

The context of the second choice differed between participants depending on which of the five treatments they were randomly assigned to. The second choice allowed them to revise their initial choice based on new information/incentives/choice sets imposed by the treatment. Participants who selected more than one product category completed the first choices for all categories before moving to the second choices and were subject to the same treatment throughout. Respondents had to complete the task independently, without the help of the experimenter.

Table 2: Sources of Carbon Footprint for the Products Included in the Experiment

Product	Source	Carbon footprint	Value of the subsidy[7]
Cola (2 liters)	Coca Cola[8] (2009)	6-can packs: 1,020 g CO2e. Plastic bottles: 500 g CO2e.	£ 0.05 for the purchase of plastic bottles over cans.
Milk (2-pint)	Tesco[9]	Skimmed milk: 1,400 g CO2e. Semi-skimmed milk: 1,600 g CO2e. Whole milk: 1,800 g CO2e.	£ 0.03 for the purchase of semi-skimmed milk; £ 0.06 for the purchase of skimmed milk.

[7] The subsidy was calculated assuming a social cost of carbon of 70 £/tonne (DEFRA, 2002, p. 41; Pearce, 2003). The following formula converts the amount of CO2e saved into £/kg

$$70\frac{£}{tC}\times\frac{12}{44}\frac{tC}{tCO_2}\times 10^{-6}\frac{tCO_2}{gCO_2}\times\Delta CF\frac{gCO_2}{kg}$$

where ΔCF is the difference in carbon footprint between dirty and clean varieties. In the case of milk and cola, the resulting value was below 0.5 pennies, and was multiplied by 10 for cola, and by 9 in the case of milk.

[8] Values refer to Coca Cola. Pepsi Cola was assumed to be similar.

Meat (various weights)	Williams *et al*. (2006)	Chicken: 5,000 g CO2e/kg. Beef: 16,000 g CO2e/kg.	£ 0.21 per kilo of chicken meat
Butter/margarine (500g)	Pendos CO2-Zähler[10]	Butter: 11,900 g CO2e. Margarine: 675 g CO2e.	£ 0.43 for the purchase of 0.5 kilos of margarine.

Incentive compatibility is ensured by checking actual purchases when participants leave the shop against their stated choices in the experiment. If purchases are in line with their experimental choices they receive a £5 voucher and (for the Subsidy and NeutralPriceChange treatments) a cash payment equivalent to the difference between the (unaltered) in-store price and the reduced price announced in the experiment. Participants are informed about this procedure upfront. At the end of the experiment demographic details of the respondents were collected.

A total of 898 shoppers made at least one dirty initial choice and hence were included in the sample analyzed. The number of participants and hence independent observations per treatment are 196 for Ban, 206 for Subsidy, 209 for Removal, 215 for NeutralPriceChange and 72 for Labeling.

656 participants chose only from one product category, 189 made choices in two, 45 in three and only 8 made purchases from all four categories. This resulted in a total of 1201 pairs of purchasing decisions in the sample.

A Model of Switching Behavior

Participants make two decisions in each product category they have indicated to be on their shopping list today. First they choose between a dirty and a clean product based on a picture of the product and its price. As the items are everyday products and participation required that subjects intend to buy an item in that category, it seems reasonable to assume that they are familiar with the product they select. Consumption of a particular product yields utility in the form

[9] Data are available on http://www.carbon-label.com/news/17.08.2009%20-%20Tesco%20Milk%20Press%20Release.pdf. Values refer to Tesco's milk, and Sainsbury's products were assumed to be similar.

[10] German publication quoted on the online website "Time for change", http://timeforchange.org/eat-less-meat-co2-emission-of-food

$$U\left(X_i, D_j\right) - P_i ,$$

(1)

where D_j are characteristics of consumer *j*, and X_i and P_i are product specific characteristics and the price of product *i*, respectively. *U* is measured in monetary units.

We focus on those participants that chose a dirty product initially. Hence, they meet the following condition,

$$U(X_i^d, D_j) - P_i^d \geq U(X_i^c, D_j) - P_i^c ,$$

(2)

where the superscripts *d* and *c* indicate the dirty and clean variety, respectively.

Treatments

After participants made their choice they are then exposed to one of five treatments. In the Subsidy treatment they learn that the government has introduced a monetary reward *S* which reduces the price of clean products. The instructions for the Subsidy treatment (here for cola) state "*There has been a price change. Products in plastic bottles have a 5p discount due to a GOVERNMENT SUBSIDY received on account of its low carbon footprint*". The price reductions for clean varieties in each product category are given in Table 2. Hence, consumers face a new set of relative prices, they are able to rank products in each category according to their carbon footprint (because only the cleaner ones qualify for the reward) and they know that the price change has an interventionist character. Hence, they switch to a clean product if and only if

$$U(X_i^d, D_j) - P_i^d < U(X_i^c, D_j) - P_i^c + S + m(X_i^c, D_j, Subsidy) ,$$

(3)

where *m(•)* indicates the net change in intrinsic motivation to buy the cleaner product. The reward, ceteris paribus, increases the attractiveness of the cleaner product. If the subsidy is able to activate intrinsic motivation (m > 0), then this too will make switching more likely.

Note that for the carbon footprint of a product to have an impact on the consumption choice of a consumer, she does not only need to care about the environmental public good affected (mitigation of climate change) but also has to have at least some form of intrinsic motivation to contribute to this cause. Intrinsic motivation is a necessary condition since the relevant population of the climate mitigation game is in the order of billions and hence close enough to infinity to drive the Nash contribution down to zero (Andreoni 1988).

When a change in relative prices equivalent to that of the subsidy is caused by market forces instead, it creates exactly the same monetary incentives as the subsidy scheme, but consumers are unable to rank products based on any signal of environmental performance. Moreover, the price change does not have an interventionist character. The instruction for the NeutralPriceChange treatment read "*There has been a price change. Products in plastic bottles have a 5p discount because of a change in the price of materials*". The switching condition in the NeutralPriceChange treatment is therefore

$$U(X_i^d, D_j) - P_i^d < U(X_i^c, D_j) - P_i^c + S \,. \quad (4)$$

Comparing the switching behavior in the Subsidy and the NeutralPriceChange treatments allows to isolate the effect of the subsidy on intrinsic motivation. The parameter *m* is the only difference between conditions (3) and (4). This gives rise to the following hypothesis:

Hypothesis 1

(a) If a subsidy activates intrinsic motivation (crowding-in), then it induces more consumers to switch to the cleaner variety than a neutrally framed price change.

(b) If a subsidy does not activate intrinsic motivation, then the switching behavior in both treatments are alike.

(c) If a subsidy activates a form of de-motivation to buy the cleaner product, then it will induce fewer consumers to switch to the cleaner variety compared to a neutrally framed price change.

The quantity-based instrument used in the experiment is a product ban. This is the most drastic form of quantity control and likely to spur the strongest reactions. Theories of motivation crowding that are based on perceptions of who is in control would predict crowding out of intrinsic motivation in such a context.

The Ban treatment restricts the choice set of participants by excluding dirty products. Again, participants are told that this is due to a government intervention. The instructions state "*There has been a change in product availability. Products in cans are not available because they have been BANNED by GOVERNMENT ORDER on account of their high carbon footprint*". Consequently, the only choice left is whether to opt out or purchase a clean alternative instead. The necessary and sufficient condition for opting out is then

$$U(X_i^o, D_j) < U(X_i^c, D_j) - P_i^c + m(X_i^c, D_j, Ban), \quad (5)$$

where X_i^o represents the outside option.

The control treatment (Removal) presents participants with exactly the same change in the choice set, but again attributes it to market forces. The switching condition becomes

$$U(X_i^o, D_j) < U(X_i^c, D_j) - P_i^c. \quad (6)$$

Whilst a ban allows consumers to rank products by their environmental performance, in the presence of a neutrally framed product removal there is no information that would allow this. "*There has been a change in product availability. Products are not supplied in cans on account of the lack of availability of the necessary materials*" are the instructions used for the Removal treatment.

Hypothesis 2

(a) If a ban activates intrinsic motivation (crowding-in), then it induces fewer consumers to opt out than a neutrally framed product removal.

(b) If a ban does not activate intrinsic motivation, then the switching behavior in both treatments is alike.

(c) If a ban activates a form of de-motivation to buy the cleaner product, then it will induce more consumers to opt out than a neutrally framed product removal.

In order to test whether information on carbon footprints of products (in CO2 equivalent units, CO2e, see Table 2) is able to activate intrinsic motivation at all, we conduct an additional treatment were we only inform participants about the carbon footprints and nutritional information of products without any change in relative prices or the choice set. The nutritional information has no significant impact on participants' choices.[11] The switching condition in the Labeling treatment is

$$U(X_i^d, D_j) - P_i^d > U(X_i^c, D_j) - P_i^c + m(X_i^c, D_j, Label). \quad (7)$$

Hence, intrinsic motivation is the only driver of any switches observed. The Labeling treatment also creates a benchmark for the scale of intrinsic motivation in the Subsidy treatment. If the effect of both interventions on intrinsic motivation is the same, then we expect to observe more switching in the Subsidy than in the Labeling treatment.

[11] The labeling treatment provided nutritional information on calories, fat, protein, carbohydrate and salt content as reported on products' packages. However, only for fat and calories (which are highly correlated with each other) are there any significant differences between the content of first and second choices. For the subsamples of participants in the Labeling treatment who consume a dirty or a clean variety throughout or who switch from the clean to the dirty variety there is no significant difference between attributes in their first and second choice. The only group where such a difference exists is the one switching from dirty to clean, which indicates that the effect is driven by the correlation between the carbon footprint and calories/fat content for some products. This test exploits the fact that nutritional characteristics vary within dirty and clean choices (e.g. 'normal' and diet cola is available both in bottles and cans).
The irrelevance of nutritional information is intuitive as it is available on product labels and hence participants that care about these attributes already take them into account in their baseline choice. Moreover, it was presented in a less salient way (in a table) rather than as a graphical label like the carbon footprint.

Hypothesis 3

(a) If the combined effect of a change in relative prices and intrinsic motivation in the Subsidy treatment is not less than intrinsic motivation in the Labeling treatment, then at least as many consumers switch under a subsidy than under a label.

(b) Only if the effect of intrinsic motivation in the Labeling treatment dominates the combined effect of the change in relative prices and intrinsic motivation in the Subsidy treatment, will we observe less switching under a subsidy than under a label.

The Econometric model

To define the econometric structure of our model, we start from the same utility function introduced in equation (1). Since our sample only includes participants who initially chose the dirty variety and hence satisfy condition (2), conditions (3) – (7) are necessary and sufficient switching conditions. For each product category *i* and each consumer *j* we can define the propensity to switch to the clean variety in that product category as the latent variable E_{ij}^{*}. Actual switching is observable and links as follows to the latent propensity

$$E_{ij} = \begin{cases} 1 & if \quad E_{ij}^{*} > 0 \\ 0 & if \quad E_{ij}^{*} \le 0 \end{cases},$$

(8)

where $E_{ij} = 1$ indicates switching. Assuming that the effects of personal characteristics are additively separable and linearly affect marginal utility, the equation to be estimated can be written as

$$E_{ij} = \alpha_0 + \alpha_1 D_j + \alpha_2 X_i + \delta T_j + \varepsilon_{ij},$$

(9)

where ε_{ij} is assumed to be i.i.d. distributed.

Since the switching conditions for a product ban and a neutrally framed removal (conditions (6) and (7)) differ from the other switching conditions not only due to the incentives/information associated with the treatment itself but also due to

the outside option, we will create two subsamples for the empirical analysis. The first comprises participants in the treatments covering labeling, a subsidy and a neutrally framed price change and the second those subject to either a ban or a neutrally framed removal. The coefficient δ of the treatment dummy T_j hence captures the difference in the propensity to switch between the treatment represented by the dummy and the one used as the baseline. Some variants of equation (9) used below will allow for interaction terms between personal characteristics and treatment dummies.

3. Results

This section presents the evidence for the different effects of price and quantity based instruments on intrinsic motivation. After a brief description of the switching pattern, we start with comparing the subsidy to the neutrally framed price change and the pure information treatment. Next the ban is contrasted with the corresponding neutrally framed control treatment.

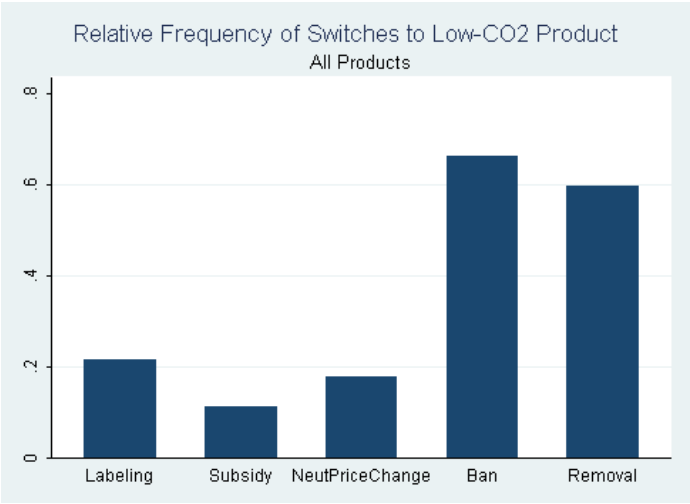

Figure 1: Relative Frequency of Switches for all Product Categories

Table 3: Relative frequency of switching by product category.

	Labeling	Subsidy	NeutralPriceChange	Ban	Removal
Cola	36.4%	27.3%	58.7%	81.6%	75.6%
Butter/Margarine	61.5%	16.1%	20.0%	70.0%	78.6%

Meat	21.1%	12.0%	14.8%	69.1%	71.4%
Milk	8.0%	5.0%	6.4%	60.3%	47.0%
All products	21.5%	11.3%	17.9%	66.4%	59.8%

The switching behavior for each treatment is presented in Figure 1 and Table 3. The Subsidy treatment induces fewer switches in all product categories than both the NeutralPriceChange and Labeling the treatments while the ranking between Ban and Removal is ambiguous on first inspection.

Subsidies and Intrinsic (De-) Motivation

A direct comparison of the number of switches in the Subsidy and the NeutralPriceChange treatments using a Mann-Whitney test confirms that participants are less likely to switch under a Subsidy (p = 0.0259). This confirms Hypothesis 1(c) and indicates that an explicit price intervention activates a form of intrinsic de-motivation. Participants become less sensitive to a change in relative prices than in a situation that does not allow interactions with intrinsic factors. Note that this effect is not driven by participants that initially bought clean products and changed their mind because of the intervention. The sample only includes participants that initially chose dirty products.

To further test for the robustness of this effect, we run a logit regression on the propensity to switch with the NeutralPriceChange treatment as a baseline. Table 4 reports results of four regressions. The regressions in columns (1) and (2) include treatment dummies and different numbers of controls. Both confirm that the propensity to switch is lower in the Subsidy than in the NeutralPriceChange treatment. In order to control for the fact that some of the observations are generated by the same participant, we cluster at the participant level (there are 493 independent observations) and include the control variable Multchanges. The latter is a dummy that takes the value 1 if and only if a participant switched in at least one other product category. It therefore captures the fact that a participant

who switches in one product category is more likely to switch in other categories as well.

Regressions (3) and (4) in Table 4 include interaction terms between treatments and log of income. It reveals that the de-motivation triggered by the subsidy is more prevalent in participants with average and above average income. The negative effect of the subsidy-income interaction term dominates the positive subsidy effect for the average participant (the mean of *lninc* in this sample is 3.25, min: 2.01 and max: 4.38). The effect of income on crowding is intuitive since poorer consumers face a tougher trade-off between money and their desire to resist government intervention.

Result 1

A subsidy induces fewer consumers to switch to clean products than a neutrally framed price change. This indicates that the price intervention activates a form of intrinsic de-motivation (over-crowding).

Table 4: Subsidy vs. NeutralPriceChange (clustered at participant level, 493 independent observations)

	(1) No Interaction Terms	(2) No Interaction Terms – selected control variables	(3) Interaction Terms	(4) Interaction Terms – selected control variables
Multchanges	1.092**	1.248***	1.040**	1.157***
	(0.011)	(0.002)	(0.015)	(0.003)
Subsidy	**-0.534***	**-0.654****	**2.464***	**2.728****
	(0.051)	**(0.011)**	**(0.055)**	**(0.018)**
Sub_lninc			**-0.925****	**-1.002*****
			(0.020)	**(0.006)**
Labeling	0.438		-1.153	
	(0.180)		(0.517)	
Label_lninc			0.497	0.162*
			(0.346)	(0.078)
milk	-2.635***	-2.662***	-2.687***	-2.718***
	(0.000)	(0.000)	(0.000)	(0.000)
meat	-1.569***	-1.541***	-1.600***	-1.594***
	(0.000)	(0.000)	(0.000)	(0.000)
butter	-0.997***	-1.012***	-1.108***	-1.127***
	(0.005)	(0.003)	(0.002)	(0.001)
L.Walthamstow	0.509	0.608*	0.623	0.708**

	(0.222)	(0.081)	(0.140)	(0.044)
hh_children	-0.265**	-0.164*	-0.230*	
	(0.029)	(0.078)	(0.064)	
lninc	0.201		0.487**	0.462**
	(0.283)		(0.047)	(0.016)
Constant	-0.428	-0.0956	-1.543	-1.797***
	(0.626)	(0.710)	(0.162)	(0.008)
Observations	666	666	666	666
Pseudo R^2	0.198	0.180	0.210	0.194
chi^2	90.76***	80.84***	102.9***	85.86***

The following control variables are insignificant in regressions (1) and (3) and are not reported: L.NewBarnet, L.Edgware, L.Chiswick, L.Merton, envinfo, nutrinfo, age, hh_size, male, student, unemployed, retired, edu1, ncsec.

Variable descriptions and summary statistics are reported in Tables 7 and 8 in the appendix, respectively.

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Subsidy vs. Labeling (clustered at participant level, 493 independent observations)

	(1) No Interaction Terms	(2) No Interaction Terms – selected control variables	(3) Interaction Terms	(4) Interaction Terms – selected control variables
Multchanges	1.092**	1.248***	1.013**	1.157***
	(0.011)	(0.002)	(0.018)	(0.003)
Subsidy	**-0.972*** **	**-0.654** **	**3.620***	**2.728** **
	(0.007)	**(0.011)**	**(0.054)**	**(0.018)**
Sub_lninc			**-1.420** **	**-1.164*** **
			(0.013)	**(0.002)**
NeutralPriceChange	-0.438		1.256	
	(0.180)		(0.468)	
Neutral_lninc			-0.522	-0.162*
			(0.309)	(0.078)
Milk	-2.635***	-2.662***	-2.664***	-2.718***
	(0.000)	(0.000)	(0.000)	(0.000)
Meat	-1.569***	-1.541***	-1.572***	-1.594***
	(0.000)	(0.000)	(0.000)	(0.000)
Butter	-0.997***	-1.012***	-1.080***	-1.127***
	(0.005)	(0.003)	(0.003)	(0.001)
L.Walthamstow	0.509	0.608*	0.593	0.708**
	(0.222)	(0.081)	(0.156)	(0.044)
hh_children	-0.265**	-0.164*	-0.220*	
	(0.029)	(0.078)	(0.084)	
Lninc	0.201		0.961**	0.624***
	(0.283)		(0.044)	(0.003)
Constant	0.0105	-0.0956	-2.423	-1.797***
	(0.991)	(0.710)	(0.149)	(0.008)
Observations	666	666	666	666
Pseudo R^2	0.198	0.180	0.209	0.194
chi^2	90.76***	80.84***	102.7***	85.86***

The following control variables are insignificant in regressions (1) and (3) and are not reported: L.NewBarnet, L.Edgware, L.Chiswick, L.Merton, envinfo, nutrinfo, age, hh_size, male, student, unemployed, retired, edu1, ncsec.
Variable descriptions and summary statistics are reported in Tables 7 and 8 in the appendix, respectively.
p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

One explanation of Result 1 is that consumers consider a high carbon footprint as something positive (e.g. because they are not familiar with the concept). To rule out this possibility and to test the interaction of a carbon footprint with intrinsic

motivation in consumers we conducted the Labeling treatment. This treatment relies exclusively upon the carbon footprint of a product without any monetary incentives.

The Labeling treatment induces a significant share of participants to switch (Wilcoxon signed rank test: p = 0.000). Hence, the information about carbon footprints was able to activate intrinsic motivation to contribute to climate change mitigation. Comparing the frequency of switching in the Subsidy and the Labeling treatments confirms that consumers are more likely to switch to clean products when exposed to the footprint information only (Mann-Whitney test: p = 0.0143). Intrinsic motivation alone is able to induce more consumers to switch in the Labeling treatment than the combined effects of a change in relative prices and information on the relative ranking of products according to their carbon footprint in the Subsidy treatment. This indicates crowding-out of intrinsic motivation by the combination of a monetary reward compared to the provision of information alone.

This is further confirmed by a series of logit regressions presented in Table 5. Again, columns (3) and (4) show that crowding-out is increasing in income.

Product bans and motivation crowding

Now we turn to the impact of a product ban on intrinsic motivation. Again, except for the framing, the Ban and the Removal treatments are identical with one exception. In contrast to the Removal treatment, the Ban treatment does convey information about the relative environmental performance of varieties. Note, however, that the dirty varieties are no longer available once this information becomes available. Participants now have to compare the clean variety against an unobservable[12] outside option.

[12] To the experimenter.

Direct comparison of switching frequencies in both treatments fails to be significantly different (Mann-Whitney test: $p = 0.1130$). The miss is however close enough to justify some further investigation using logit regressions.

Controlling for a set of consumer specific characteristics makes the treatment dummies in regression (1) and (2) of Table 6 significant. Hence, fewer consumers opt-out under a product ban than when the same change in the choice set is attributed to market forces. Regression (4) indicates that again income is driving this result.

Table 6: Ban vs. Removal (clustered at participant level, 405 independent observations)

	(1) No Interaction Terms	(2) No Interaction Terms – selected control variables	(3) Interaction Terms	(4) Interaction Terms – selected control variables
Multoptout	0.860***	0.881***	0.835***	0.870***
	(0.006)	(0.004)	(0.009)	(0.005)
Ban	**-0.341***	**-0.369****	**0.497**	
	(0.076)	**(0.049)**	**(0.595)**	
Ban_lninc			**-0.259**	**-0.121****
			(0.359)	**(0.031)**
milk	1.434***	1.349***	1.439***	1.349***
	(0.000)	(0.000)	(0.000)	(0.000)
meat	0.639	0.545*	0.637	0.545*
	(0.101)	(0.080)	(0.102)	(0.080)
butter	0.199		0.203	
	(0.631)		(0.626)	
L.Merton	-0.742**	-0.588***	-0.732**	-0.593***
	(0.012)	(0.005)	(0.013)	(0.005)
unemploy	-1.047**	-0.972**	-1.035**	-0.967**
	(0.016)	(0.017)	(0.016)	(0.016)
retired	-1.411	-1.441*	-1.432	-1.437*
	(0.125)	(0.092)	(0.125)	(0.094)
lninc	0.271	0.189	0.404*	0.250*
	(0.102)	(0.186)	(0.069)	(0.086)
Constant	-1.733**	-1.756***	-2.225**	-1.936***
	(0.048)	(0.001)	(0.033)	(0.000)
Observations	535	535	535	535
Pseudo R^2	0.095	0.086	0.096	0.087
chi2	58.51***	50.91***	59.03***	51.22***

The following control variables are insignificant in regressions (1) and (3) and are not reported: L.Walthamstow L.NewBarnet, L.Edgware, L.Chiswick, envinfo, nutrinfo, age, hh_children, hh_size, male, student, edu1, ncsec.

Variable descriptions and summary statistics are reported in Tables 7 and 8 in the appendix, respectively.

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Result 2

A product ban activates intrinsic motivation. Consumers are less likely to opt-out if a product is banned than if it becomes unavailable for other reasons.

Combining Results 1 and 2 we find substantially different effects of price and quantity based instruments on intrinsic motivation. While a subsidy crowds out intrinsic motivation and can even turn it into de-motivation, there is (somewhat weaker) evidence of crowding-in for a ban. This is in line with the general predictions of Frey (1992) but contrasts with some previous findings in the literature (e.g. Falk and Kosfeld, 2006). However, the latter does not consider a public good setting and does not provide a comparison between a price and a quantity instrument but focuses on the latter exclusively.

4. **Conclusions**

Our findings provide the first direct comparison of price and quantity instruments in a field experiment based on real consumer purchasing decisions. We find marked differences between the two types of instruments in the way they interact with intrinsic motivation. A subsidy crowds-out (and even 'over-crowds') intrinsic motivation while a ban (weakly) crowds-in.

To summarize the key results, information provision through labeling is able to induce shoppers to switch to more climate friendly product varieties due to their intrinsic motivation to contribute to climate change mitigation. However, combining information on the relative environmental performance of products with a monetary reward for switching is less effective than information alone (crowding-out). Moreover, using a subsidy as an explicit regulatory intervention performs worse than an equivalent but neutrally framed price change where no intrinsic motivation is present (over-crowding). This indicates that the framing of otherwise equivalent changes in the incentive structure matter for intrinsic motivation. Goeschl and Perino (2009) observe crowding out of pre-existing intrinsic motivation by an environmental tax compared to a neutrally framed price change. Hence, they find evidence that motivation is reduced, but not that it becomes 'negative'.

The policy implications of our results are as follows. We are investigating the ability of various instruments to channel intrinsic motivation toward the supply of public goods. What works?

Our initial finding is that Labeling can be an effective element in the utilization of the intrinsic motivation of consumers to change their diets to become less carbon intensive. It is interesting to note that approximately twenty per cent of the consumers require only this “nudge” to give effect to their own motivation.

Our second finding is that a change in relative prices also has a clear positive impact but the scale of that impact depends upon consumers’ perception of the origin of that price effect; specifically, governments perceived to be acting through the price mechanism generate negative interaction effects with the affected public. Hence, a governmental intervention that is highly visible to consumers might be less effective than a ‘hidden’ tax or subsidy that is applied further upstream and does not appear as such on the price of products. Explicit governmental nudges conveyed through the price mechanism generated negative responses.

Finally, the use of the instrument of an outright ban is of course most effective in inducing consumers to switch to a cleaner variety; however, the switching rates are still clearly below one hundred percent. Depending on the characteristics of the outside options consumers choose to buy instead, the impact on GHG emissions is not obvious. Clearly, though, the quantity-based instrument does not generate the negative response amongst consumers as does the price-based instrument.

Taken together, the results from this experiment suggest that a government working in an area imbued with intrinsic motivations should proceed carefully in its selection of instruments. Unlike the suggestions of basic theory, not all instruments give effect to intrinsic motivation in the same way. Price-based

instruments can interact negatively with intrinsic motivations and quantity-based instruments can interact less so (and even weakly positively).

The upshot of this experiment is that the way information is conveyed to the public matters when attempting to nudge it in a given direction. When the public is imbued with intrinsic motivations to go with the nudge, then a simple nudge (basic information) provides an effective instrument for moving many of those involved. A nudge conveyed explicitly through the price mechanism has a pronouncedly negative impact on the consuming public; they do not wish to be nudged in this fashion. The fact that the price instrument is less effective than labeling information alone indicates that this sort of information transmission is unwelcome. This is especially so amongst the high income groups – who demonstrate that they are willing to supply public goods voluntarily more readily than by reason of income-based coercion. Finally, a quantity-based restriction appears to overcome much of this reticence, perhaps by creating the perception that the burden of provision is more equitably shared.

A number of caveats are in order. Firstly, the experiment can by its design only capture short term effects. The willingness to switch might be substantially different in the long-run. Hence, the absolute levels of switches should be treated with caution. The focus is on the relative performance of instruments and on the interactions with intrinsic motivation. Secondly, the credibility of the framings can be questioned on the grounds that participants were fully aware that they are participating in an experiment and that any subsidy, price change, ban and product removal would not be permanent and that any government involvement might be purely hypothetical. However, if participants would indeed have found the framing unconvincing, we should not have found any significant effects between the Subsidy and the NeutralPriceChange or the Ban and the Removal treatments. The fact that we did, indicates that the setup did work as intended.

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Appendix

Table 7: Variable Descriptions

Variable	Description
	Multiple switch dummies
Multchanges	Dummy: 1 if participant switched in at least one of the other product categories, 0 otherwise
Multoptout	Dummy: 1 if participant opted out in at least one of the other product categories, 0 otherwise
	Treatment dummies
Labeling	Dummy: 1 if participant was subject to Labeling treatment, 0 otherwise
Subsidy	Dummy: 1 if participant was subject to Subsidy treatment, 0 otherwise
NeutralPriceChange	Dummy: 1 if participant was subject to NeutralPriceChange treatment, 0 otherwise
Ban	Dummy: 1 if participant was subject to Ban treatment, 0 otherwise
	Product dummies
milk	Dummy: 1 for milk, 0 otherwise
meat	Dummy: 1 for meat, 0 otherwise
butter	Dummy: 1 for butter/margarine, 0 otherwise
	Location dummies
L.NewBarnet	Dummy: 1 if observation is from store in New Barnet, 0 otherwise.
L.Edgware	Dummy: 1 if observation is from store in Edgware, 0 otherwise.
L.Chiswick	Dummy: 1 if observation is from store in Chsiwick, 0 otherwise.
L.Merton	Dummy: 1 if observation is from store in Merton, 0 otherwise.
L.Walthamstow	Dummy: 1 if observation is from store in Walthamstow, 0 otherwise.
	Socio-demographic variables
envinfo	Dummy: 1 if participant opts to read the environmental information sketching the problem of climate change and the meaning of a carbon label, 0 otherwise.
nutrinfo	Dummy: 1 if participant opts to read the nutritional information sketching the health impact of energy, proteins, carbohydrates, fat and salt referred to on food labels, 0 otherwise.
hh_children	Number of children (below 12 years old) in the household
hh_size	Number of persons living in a household
male	Dummy: 1 if participant is male, 0 otherwise.
student	Dummy: 1 if participant is a student, 0 otherwise.

ncsec	Socio-economic class, based on participants' occupation in accordance with UK Office for National Statistics 2005 guidelines.
Unemployed	Dummy: 1 if participant is unemployed, 0 otherwise.
Edu1	Dummy: 1 if participant does not have any university-level education, 0 otherwise.
lninc	Log of income

Interaction terms

Label_lninc	Labeling x lninc
Sub_lninc	Subsidy x lninc
Neutral_lninc	NeutralPriceChange x lninc
Ban_lninc	Ban x lninc

Table 8: Summary Statistics

Variable	Mean	Std. Dev.
Multchanges	0.20	0.40
Multoptout	0.08	0.27
Labeling	0.08	0.27
Subsidy	0.22	0.42
NeutralPriceChange	0.26	0.44
Ban	0.22	0.41
milk	0.53	0.50
meat	0.18	0.39
butter	0.14	0.35
L.NewBarnet	0.07	0.25
L.Edgware	0.17	0.38
L.Chiswick	0.20	0.40
L.Merton	0.29	0.45
L.Walthamstow	0.10	0.30
envinfo	0.38	0.48
nutrinfo	0.57	0.49
hh_children	0.63	1.01
hh_size	2.97	1.61
male	0.38	0.49
student	0.07	0.26
ncsec	8.43	4.21
Unemployed	0.05	0.22
Edu1	0.39	0.49
Income (in '000)	31.1	18.50