How do Nudges Work?

Designing Instruments to Guide Consumers Towards "What They Want to Achieve"

Denise Leung
Luca Panzone
Tim Swanson

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1 Introduction

International policy agendas are increasingly focusing on environmental protection, and there is a growing consensus that more rational "carbon policies" should be developed. This term refers to policies that address environmental problems, regulate the steps needed to reduce externalities, and stimulate sustainable consumption. The design of an effective carbon policy requires a thorough understanding of all the actors involved in the production of greenhouse gases (GHGs) and their reaction when different instruments are used (see e.g. Metcalf and Weisbach, 2009; Weisbach, 2009).

Food consumption plays an important part in the production of GHGs. Due to the energy produced by food production and delivery, demand for food products is a major part of a household's carbon footprint (Carlsson-Kanyama and Gonzales, 2009; Eshel and Martin, 2006; Weber and Matthews, 2008). This is an interesting area, since food is an important and essential part of a household's expenditures. However, improvements in a household's carbon footprint from food consumption can be relatively inexpensive (at least in the short run), as they do not necessarily require investments in new technology; instead, they can hinge on consumer choice. The choices people make also depend largely on a variety of factors, including "nudges."

1.1 Nudges

The assumption that people act rationally, given whatever constraints they face, is the basis of traditional economic policy. In creating new policies, economists have generally assumed that individuals have steady, predictable preferences, and policy-making has been based upon this presumption. Recent behavioral economic theory, however, has shown that people do not always act in their best interest; individual decision-making is not as rational as economists previously thought. In 2003, Sunstein and Thaler[1] proposed a new concept called libertarian paternalism, part of a larger body of thought called soft paternalism. Sunstein and Thaler's theory, and all of these other paternalistic theories, generally center around the concept that individuals make poor choices based on incomplete information, lack of self-control, and an absence of full mental capacity. Therefore, policy makers should use regulatory commands to make people choose what their true preferences would be, if they were fully aware. Due to these factors, someone called a "choice architect" should help people make decisions through nudges.

A choice architect is a person or entity, such as a government, that designs a framework of choices that encourages choosers to make decisions that make them, the choosers, better off. The concept of "better off" is subjective, but according to Sunstein and Thaler, individuals would be making choices that they would have made if they had complete information and self-control. They would be choosing the option

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[1] Richard H. Thaler and Cass R. Sunstein *Nudge : Improving Decisions About Health, Wealth, and Happiness* (New Haven: Yale University Press, 2008).

they really wanted to choose. In theory, choice architects do not impose their own views on what individuals should choose; they simply make it easier for choosers to use their own judgments about what they want. Choice architects design policy so choices are arranged in a way that make people choose an option most in line with their well-being and what they truly want in the long-term.

"Nudges" is an acronym for iNcentives, Understanding mapping, Defaults, Giving feedback, Expecting errors, and Structure of complex choices. It is based on the idea of libertarian paternalism. While both of these words may carry certain connotations, especially when combined, they are defined in this context as liberty-preserving.[2] The libertarian part of the concept is that people should be free to live their lives as they wish, and have the ability to select other options if they are in an unsuitable or undesirable situation. The paternalistic part refers to the argument that choice architects should be able to impact people's choices and lives to make their lives better. Nudges are based on the idea that institutions can influence choices in a subconscious way that will improve the individuals' lives. Libertarian paternalism is meant to describe a society where people are free to do what they want and make decisions as they would ideally make them.

The fundamental idea behind nudges is that choice architects alter the behavior of individuals in a predictable way without excluding any options or changing economic incentives. There is a clear line between nudging and coercion. The classic example given in *Nudge* is that of students in a cafeteria. In an effort to make the students to eat healthily, choice architects could instruct cafeteria workers to put fruit at eye level. This constitutes a nudge towards healthy eating. However, banning junk food would not be a nudge.

In creating policy, governments should take into account the fact that people make errors in judgment. Currently, policies are created under the assumption that people are rational, and will choose what is best for them. However, this is not the case. Policy makers should structure choices that support, but do not require, options that maximize well-being. In a way, choice architecture is already in practice in many parts of life, so some argue that it should be used to optimize choices. Another way to view choice architecture is that it can correct unconscious biases or use biases to encourage people to behave in a certain way. Some schools of thought, including neoclassical economics, oppose regulation, but would concede that in situations where information provided is incomplete or imperfect, regulation could be one solution to correct this bias.[3] Regulation is another way to ameliorate situations where too much, or unclear, information is given to individuals.

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[2] Sunstein and Thaler, *Nudge*, (2008) 5.

[3] O Lobel and O Amir, "Stumble, Predict, Nudge: How Behavioral Economics Informs Law and Policy"(2008) 108 *Colum L Rev* 2098, citing RA Epstein, "Behavioral Economics: Human Errors and Market Corrections" (2006) 73 U Chi L Rev 111, 128.

Nudges can be used by governments to encourage in environment-saving measures.[4] However, governments generally use more coercive tactics than the nudge. In fact, environmental policies tend to consist of mandates instead of nudges. This makes them not libertarian because individuals are not experiencing free choice and markets. For example, there are many governmental regulations that set targets, mandate that environmentally-friendly technology is used, or raise taxes on certain actions. While these regulations do not necessarily state exactly what technology must be used, this constitutes more than a nudge.

In some situations, nudges can take the form of personalized feedback, and can be used to help people understand the direct results of their actions. This is useful because individuals are often unaware of the long-term effects of their behavior, and using nudges can help illuminate these effects. For example, electricity customers in California were divided into two groups; one group received emails and text messages about their energy use, and the second group received an ambient orb that was placed in their homes. The orb glowed green when little energy was being used, and turned red when energy use was high. The first group did not significantly change their energy use, but the second group reduced their energy use by 40% during peak periods.[5]

In another experiment, researchers at the University of California Transportation Center conducted three experiments. The first was an experiment to see if people could be nudged towards sustainable behavior by giving them personalized and context-specific information.[6] It involved route choice, where subjects were shown three possible routes to get to a recreational area with friends. The routes were described by travel time, toll costs, GHG emissions, and safety. Respondents were presented with three routes, out of which they selected one. There were five different sets of routes presented to each respondent. Results show that respondents were strongly influenced by the fact that each route showed the GHG emissions for each route. Results imply that when people understand alternative choices, and the relative environmental impact of those choices, they will consider this information and choose the more sustainable option.

In the second experiment, researchers examined whether social influence, such as knowing what other people are doing or buying, will impact environmentally related purchasing decisions. Subjects were given a description of a new job with a specific salary, and a house either in a mixed-use or suburban area. Then they were given information about the commute to work, both by car and by public transportation. Researchers presented information for both a conventional and hybrid car, including purchase price, operating cost, and GHG emissions. They then revealed what other

[4]Sunstein and Thaler, *Nudge*, (2008) 193.

[5] D Gaker, Y Zheng, J Walker, "Experimental Economics in Transporation: A Focus on Social Influences and the Provision of Information" (2010) University of California, Berkeley.

[6] Gaker, Zheng, and Walker, *Experimental Economics*, (2010).

people were choosing- a conventional car, a hybrid, or no car. The subject was then asked to choose their own method of transportation. Results reveal that people were, in fact, influenced by the choices of other subjects.

The third experiment involves testing whether posting information on social norms at pedestrian crosswalks is more effective at changing safety behavior than traditional information about accidents, fines, and citations. For example, signs showed information about specific incidents where people were fined for crossing on a red light. Other signs revealed what percentage of people crossed legally or illegally at intersections. Researchers found that information on social norms, such as the behavior of other people at intersections, has a significant impact on safety behavior.

Clearly, nudges are an effective way to change people's perceptions, and, ultimately, their choices. When designed and implemented properly, they can shift consumers' consumption habits towards certain practices, such as lower GHG practices.

1.2   Nudges and sustainable consumption

This paper advises on the design of a carbon policy targeting household food consumption, a major part of a household's GHG production. The choice experiment, upon which this paper is based, tests consumer response to different policy instruments, or nudges, while choosing food. Surprisingly, this is an area of study where little research has been done. While there is increasing evidence that diet has a much stronger impact on GHG emissions than commonly thought (Carlsson-Kanyama and Gonzales, 2009; Eshel and Martin, 2006), current literature presents little empirical analysis on this topic.

The choice experiment tests consumers' responses to different policy instruments using a real-life experiment. Consumers are given one of five different policy instruments aimed at reducing their carbon footprint. These instruments are meant to encourage them to purchase the more environmentally friendly food option in the food category in which they are already shopping. These five instruments can be grouped into three categories:

   a. **Price instruments**: These favour the least polluting alternative, which is made relatively cheaper. These instruments appear in the form of:
      i.   a subsidy;
      ii.   an exogenous price change;
   b. **Quantity instruments**: These prohibit the most polluting alternative, via:
      i.   a ban;
      ii.   an exogenous product removal;
   c. **Information instruments**: A labelling scheme that informs consumers of the carbon footprint of the different options in the category.

The inclusion of exogenous changes in price and availability allows for the analysis of a scenario where the economy, and not policy makers, causes structural changes. This allows a direct comparison between the effects of a "natural" change, where no intervention is in place, and a policy-induced change for both the price and quantity

scenarios. To analyse consumers' responses to these different instruments, revealed preference data were collected in a simulated online survey given in seven supermarkets in the greater London area.

2 Background

The responsibility of individual households in reducing carbon emissions is currently under debate (Vandenbergh and Steinemann, 2007). Individuals play a significant role in the overall amount of GHG emitted, mostly in developed countries; targeting their behaviour is thought to achieve greater benefits than could be achieved in most sectors in an economy (Vandenbergh and Steinemann, 2007). However, regulation at the household and individual levels creates implementation and control problems; Regulation is sometimes preferred at the firm level, which is then passed onto consumers (Metcalf and Weisbach, 2009).

2.1 Quantity vs Price Instruments

Different policy instruments can be used to achieve a successful reduction in individual GHG emissions,. From an economic perspective, each instrument hinges on a slightly different theoretical basis, and treats the damage in different ways. For instance, a **ban**, or a *sanction*, of one or more stages of the production process forbids the supply of the environmentally unfriendly behaviour. A sanction/ban defines exactly what can and cannot be done. Another option, a **tax**, which is essentially a *price*, quantifies the damage caused by such behaviour. Unlike a ban, a tax allows individuals to do everything they were previously able to do, provided they pay the total external costs they may cause. Despite their disparate perspectives, these two approaches converge on a single idea: a prohibition assumes infinite external costs caused to society by anti-social behaviour (the environmental problem), and the internalisation, in theory, raises the price of the activity to infinite, resulting in the prohibition of such activity.

A ban on certain products would either prohibit the supply of the most polluting alternatives in each food category, or would prohibit any non-carbon-neutral production process. However, a prohibition may not prove effective if the utility of present consumption is high (Becker et al., 2006). This occurs with products that have high own-price elasticity that are not easily substituted. This is because large price increases will generate a small decrease in overall consumption. If individuals are attached to the banned goods, they will be less sensitive to higher prices, and will end up purchasing them in illegal markets. The substantially higher market prices for an illegally-supplied product would not deter consumers because of the high utility of present consumption.

The logic behind a tax is more straightforward. Environmental taxation fulfils a criterion known as the "polluters pay principle"; it incorporates, in the full price of a good, all those costs not directly paid by the producer (Coase, 1937). Taxation increases the total cost of supplying the good, and its higher market price will endogenously determine a lower quantity demanded. This will not eliminate the externality, but will neutralise its effects, reaching the optimal amount of pollution where all external costs are paid for. The revenues from environmental taxation may then be used to cover the costs caused by pollution.

The choice between these two policy instruments is not necessarily straightforward. The choice partially depends on the ability of the government to price the crime (Cooter, 1984), which is complex for non-market goods, such as the environment. In the case of environmental externalities, the correct level of taxation is difficult to evaluate because damages affect non-market goods, e.g. landscape, personal health, or animal extinction. This makes sanctions the most viable option. However, the non-market valuation of goods can be assessed by surveying stakeholders, and can provide reliable results.

2.2 Environmental Labelling

Another approach to reducing GHG emissions is through environmental labelling, which involves reporting the carbon footprint of each good in the market (O'Neill, 2009). This requires the use of voluntary private funds to internalise environmental costs, and it means that consumers, through their knowledge and choices, are responsible for change. This also requires sign a new label.

When labelling is voluntary, the presence of the information not only provides consumers with information on GHG emissions, but it also acts as a quality signal: only firms that care about the environment, and can be proud of their low carbon footprint, will provide such information. In this way, consumers may be nudged towards choosing a lower-emission product. If the inclusion of the carbon footprint is made compulsory through legislation, producers will compete to reduce their carbon footprint; this competition could, in theory, drive GHG emissions down until they reach carbon neutrality. However, this depends on the existence of a demand for environmental quality, as this type of policy aims to attract environmentally conscious consumers. If successful, the externality is reduced using private funds, and only requires limited public intervention through legislation and awareness-raising campaigns.

The success of carbon labelling in improving sustainable consumption depends on three crucial factors:

1. If consumers are interested in the environmental information (Kaiser et al., 1999).
2. If they are able to process and interpret such information (Boardman, 2008).
3. If they are willing to pay for this quality signal (Spence, 2002).

Previous research has addressed all three points. First, consumers are not always interested in the environmental impact of their food choices (Kemp et al., forthcoming; Sirieix, 2008). This lack of interest can be caused by economic pressures (i.e. a tight budget constraint), or by low priority of such information compared to other factors. In labelling, consumers' interest in environmental quality is essential, and awareness campaigns may improve low baseline levels. Second, with the level of information given on a package, consumers may still not fully understand the environmental problem (McCaffrey and Buhr, 2008). Even when consumers have an interest and would like to be given ethical (and environmental) information, they may refrain from requesting or using it in order to avoid negative emotions while shopping (Ehrich and Irwin, 2005). Finally, a quality signal from the supply side requires a

price premium (Spence, 2002), and consumers seem to value certain aspects of environmental sustainability (Carlsson et al., 2007). This is particularly important because consumers respond better to environmental stimuli when a third party certifies the claim, as it allows the economic viability of such claims. (Cason and Gangadharan, 2002)

Despite these issues, the efficacy of carbon footprint labelling has not yet been clearly established. Experimental evidence shows that this type of label has a positive effect on consumer choice, namely when the cleaner product is also the cheaper option (Vanclay et al., 2010). However, market applications of environmental labelling on food have only been tested recently, and limited data is currently available. Marketers believe that environmental labelling in food markets is necessary to convey information, and believe that their rising importance is a consequence of both demand and supply needs (Charles, 2010). Therefore, despite limited evidence on consumer behaviour and environmental labelling, many retailers have chosen to label their store-brand products, as well as to supply a variety of privately labelled alternatives (Billon, 2009; Wyers, 2009).

2.3 The Experiment

These three different policy instruments currently being examined - labelling, tax, and ban - are tested using a consumer choice experiment. Economic theory generally assumes, both implicitly and explicitly, that taxes, when imposed for a certain purpose, creates a standard. (Cooter, 1984). Carlson et al. (2007) support this idea, showing that, for genetically modified food, willingness-to-pay for equals that of a ban, suggesting the labelling and bans have the same impact on consumer choice. However, consumer responses do not necessarily prove this point. While the general objective of regulation is to remove all environmental externalities, the removal of the source of the problem, or charging the polluter for the external costs caused, may yield different results. Similarly, the use of private instruments, based on private incentives such as labelling, can also yield different outcomes compared to other forms of regulation.

Consistency of response to a policy instrument might not be predictable, given environmental externalities. People might react to governmental intervention (a ban and tax) by leaving the marketplace in protest, which is a phenomenon called "crowding out" (Eckel et al., 2005). This is particularly relevant for price instruments, which, unlike quantity regulation, appear to crowd-out intrinsic motivations (Goeschl and Perino, 2009). Similarly, additional information on the label may prove ineffective because of the bounded rationality affecting consumer ability to process information (Gigerenzer and Goldstein, 1996). Taxes could have a milder effect on consumer choice than a ban, which is an extreme form of intervention.

To explore this research question further, an experiment observing food choices was conducted on consumers in the United Kingdom. People who already had a relatively polluting item in their shopping list were invited to take the survey. They were then given the opportunity to switch to an environmentally sustainable option. Data were then analysed econometrically, using the model presented in Annex 1. The aim was to understand whether response to environmental information depends on the instrument used.

3 Survey and Data

Data on consumer choice was collected in February and March 2010 in large Sainsbury's supermarkets in the Greater London area. Sainsbury's accounts for around 27% of the total market share in the study area[7] (16% in all the UK). Sainsbury's also has a popular online shopping site that reaches 88% of the total UK population, with over £500 millions worth of sales in 2009.[8] The survey covered the following areas in Greater London: 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 survey lasted 4 days. There were a total of 1,225 respondents in the experiment.

The survey was completed at a computer that simulated an online shopping experience. A response station of four laptops was set up in the entrance of each supermarket. To remove the presence of an investigator bias, respondents had to complete the task independently, without the help of the surveyor, whose presence was only logistical. A full visualisation of the survey is included in the appendix.

Customers entering the store were screened for participation in the experiment. They were asked if they intended to purchase any of the following items that day: beef, butter, canned cola, or milk. Respondents were enrolled only if their initial choice was a polluting item (cola in cans, butter or beef). In the case of milk, no screening was in place. Those who gave an affirmative answer were invited to participate in the experiment, and in exchange for their time, they were offered a £5 voucher, which they could collect upon exiting the store with proof that they had purchased the products they indicated in the survey. The £5 voucher was valid for two years, and could be used on any item in any Sainsbury's store

The survey collected information on consumer behaviour relating to items in four categories: cola, drinks, milk, meat, and butter/margarine. Respondents needed to be shopping for something in at least one of these categories. Each category contained both friendly and unfriendly products, and they were structured as follows:

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.

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[7] Information available on http://www.j-sainsbury.co.uk/index.asp?pageid=451

[8] 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.

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.
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.

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

Product	Source	Carbon footprint	Value of the subsidy[9]
Cola (2 liters)	Coca Cola[10] (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[11]	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.
Meat (various	Williams *et al*. (2006)	Chicken: 5,000 g CO2e/kg. Beef: 16,000 g CO2e/kg.	£ 0.21 per kilo of chicken meat

[9] The subsidy was calculated assuming a social cost of carbon of 70 £/tonne (DEFRA, 2002, p. 41; Pearce, 2003).

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.

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

[11] 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.

weights)				
Butter/margarine (500g)	Pendos Zähler[12]	CO2-	Butter: 11,900 g CO2e. Margarine: 675 g CO2e.	£ 0.43 for the purchase of 0.5 kilos of margarine.

The body of the survey consisted of three consecutive steps:

- o Step 1: Respondents indicated which category they intended to purchase from on that shopping trip (meat, milk, butter/marg, cola). They then had to specify which product they were going to purchase. They could select as many categories and products as they wished. This choice indicated an intention to purchase, rather than an effective revealed preference. However, since respondents at that stage were not completely aware on what products would be available in the following steps, they were expected to accurately select what they planned to purchase.

- o Step 2: Individuals were given the option to read information on environmental and nutritional matters associated with food markets and production. This included a description of why environmental/nutritional information is relevant, and how it can be interpreted when reading a label. Respondents with no interest in either of these two types of information could opt out and go directly to the final survey step.

- o Step 3: After reading or skipping the information provided, individuals were given the chance to either confirm or reject their initial choice, and select the product they intended to buy. Again, the list of alternatives contained a list of both "polluting" and "non-polluting" items. At this stage, respondents were reminded that their choice would be binding; they would need to purchase the item chosen at this stage in order to receive the £5 voucher. This was a key condition of the survey; the data collected consists of revealed (not stated) consumer preferences for sustainable food consumption, and indicates real market behaviour.

In the third step of the survey, respondents were randomly assigned to one of five treatments (described below) as they made their final choice. Each scenario represented a different market condition; in three cases, this was determined by different policy instruments: compulsory labelling, tax, and ban. The scenarios were as follows:

1. *Labelling*: For each category of food selected, respondents were shown a part of the label containing both nutritional and environmental information. While the nutritional information was taken directly from the real label of the product, the carbon information originated from different sources:

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

- Cola: Values for colas were obtained from a publication from Coca Cola (Coca Cola, 2009), under the assumption that Pepsi would be rather similar. This source indicated the carbon footprint for cans (1020 g CO_2) and plastic bottles (500 g CO_2) for 2 litres of the drink.

- Milk: Values for milk were obtained from Tesco, who have already labelled their products. This source reported 700, 800, and 900 g CO_2 for a pint of whole, semi-skimmed, and skimmed milk respectively.[13]

- Meat: Values for beef and chicken in the UK were found in Williams et al. (2006), who reported the total carbon footprint for chicken at 5,000 g CO_2 and beef at 16,000 g CO_2 per kg of meat.

- Butter and margarine: Values for carbon footprints were not readily available. The values used for butter and margarine were obtained from the website "Time for change"[14] that cited the German publication Pendos CO2-Zähler. Here, values for CO_2 were reported as 11,900 CO_2 per kg of butter and 675 g CO_2 per kg of margarine

2. *Tax*: In this scenario, respondents were offered the same alternatives as in the first stage, but the "cleaner" alternatives were available for purchase at a lower price. This was the effective price they would have paid, and "changers" (people who initially chose the dirtier option and then switched to the cleaner option) were reimbursed for the price difference upon collection of the voucher. Respondents were then told there had been a price change. For example, in the case of cola, they were told that "There has been a price change. Products in plastic bottles have a (*value*) p discount due to a GOVERNMENT SUBSIDY received on account of its low carbon footprint".

The value of the tax was calculated starting from the estimated social cost of carbon of 70 £/tonne, as reported by DEFRA (2002, page 41) and commented on by Pearce (2003). This was then converted into £/kg of product using the following conversion equation

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

where CF indicates the carbon footprint, and Δ indicates the difference between friendly and unfriendly alternatives. In the case of milk and cola, the resulting value was below 0.5 pennies, and therefore invisible to consumers. Consequently, in the case of cola, the resulting value was multiplied by 10, while in the case of milk, instead of the difference in carbon footprint (200 gCO_2), the value used was the full carbon footprint of whole milk (1800 gCO_2). The resulting taxes were: £0.05 for 2 litres of cola; £0.03 for 2 pints of semi-skimmed milk, and £0.06 for 2 pints of skimmed milk; £0.21 per kilo for

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[13] Data are available on http://www.carbon-label.com/news/17.08.2009%20-%20Tesco%20Milk%20Press%20Release.pdf

[14] http://timeforchange.org/eat-less-meat-co2-emission-of-food

chicken meat (then calibrated by the weight of the alternative chosen); and £0.43 for 500g of margarine.

3. *Price change*: This scenario was identical to the tax scenario. However, the screen that appeared instead stated that there had been a price change. For example, in the case of cola, it stated: "There has been a price change. Products in plastic bottles have a (*value*) p discount because of a change in the price of materials".

4. *Ban*: The polluting alternatives were removed from the list of choices, leaving respondents to choose between either the clean item and no product at all. Those respondents unwilling to purchase the products offered could opt out by choosing the "None of the above" option, and in this case, the respondent was recorded as not changing (i.e. confirming his initial choice). This scenario was explained using the following wording (*in the case of cola*): "There has been a change in product availability. Products in can are not available because they have been BANNED by GOVERNMENT ORDER on account of their high carbon footprint"

5. *Removal*: This scenario was identical to the ban scenario. The absence of some of the products was explained by the following statement (*in the case of cola*): "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".

At the end of the survey, a positive change was recorded for those individuals who switched from a relatively "dirty" option to a relatively "clean" one (e.g. those who switched from beef to chicken). All people who opted out in the ban and removal treatments were coded as "no change".

After the experiment, respondents reported their demographic details and answered a series of questions about their shopping habits and environmental beliefs. At this stage, respondents were asked to rate the importance they give to a certain number of labelling signals commonly found in the food sector on a 5-point Likert scale (1 – not important at all; 5 – essential). These include:

- Dietary signals:
    - Special dietary recommendations;
    - High fibre content;
    - Low fat;
    - Low salt;
- Socio-economic interests:
    - Country of Origin;
    - Fair price for farming;
    - Fair trade;
    - Low price;
- Environmental signals:
    - Animal welfare;
    - Local origin;
    - Organic;

- o Seasonality;
- o Recyclable packaging;
  - ▪ Private interests:
    - o Low time of preparation;
    - o Personal taste;
    - o Recognisable brand;
    - o Religion;
    - o Vegetarian.

Finally, respondents were asked about personal opinions on climate change-related matters, indicating the level of agreement on a 5-point Likert scale (going from 1 – completely disagree, to 5 – completely agree). Topics included personal attitudes toward climate change, and personal and governmental responsibility in dealing with the issue. Statements were worded as follows:

- ▪ Belief in climate change and its consequences:
  - o Climate change is a dangerous global threat.
  - o Humans are responsible for climate change.
  - o Britain should keep trying to combat climate change, even if other countries do not do so and sometimes cancel out what we do.
  - o The effects of climate change worry me, even if their impact is far in the future.

- ▪ Belief in the importance of private responsibility in tackling the environmental problem:
  - o It's worth me doing things to help the environment even if others don't do the same.
  - o Care for the environment has a high priority compared to other things in my life.
  - o I believe my everyday behaviour and lifestyle can contribute to climate change.
  - o It is worth being environmentally friendly even if this does not save you money.
  - o People have a duty to recycle.

- ▪ Belief in the importance of governmental responsibility in tackling the environmental problem:
  - o The government will take the correct action to support climate change mitigation, if there is adequate information to support that policy.
  - o Government intervention is the most effective option to combat social problems such as climate change.

In addition to the primary data collected in the online survey, a set of secondary data was included in the analysis to complete the dataset. Respondents were asked about their occupation and country of origin, and this information was then used to add other relevant information to the dataset. The individual level of human development of every respondent was determined from information on their country of origin by using the Human Development Index (HDI) of the United Nations (UNDP, 2009). This variable captures whether individuals from more developed countries have a

more developed perception of the need to address environmental problems.[15] Finally, information regarding the occupation of the respondent was used to identify social class. This data was coded in accordance with the information delivered by the UK Office for National Statistics (Office for National Statistics, 2005).

4 Results

The data collected in the survey have been analysed to determine consumer reaction to different instruments and nudges, and to consider the implications of their behaviour on future policies. This section reports the results of the econometric model presented in Annex 1. The objectives of this section are:

  a. To understand how demographic characteristics shape consumer perception of the environmental problem (CO_2 emissions) and how consumers incorporate this information into their shopping. Different shopping motives and beliefs are obtained using a factor analysis, grouping different sets of variables related to the importance given by the consumer to different common quality signals, and to different statements on climate change;

  b. To test whether different instruments influence consumer behaviour in a similar fashion. The expectation is that quantity constraint might have a stronger impact on change than price incentives (Goeschl and Perino, 2009) and the supply of information (Ehrich and Irwin, 2005), because of the lack of availability makes it impossible for consumers to adjust (i.e. it changes the structure of the choice set).

This section reports the results of each of these research questions, presenting the key points emerging from the data analysis. The structure of the conceptual model is presented in figure 1. The model assumes that demographic characteristics of respondents influence change at two different levels. First, the characteristics of the respondent are expected to determine the social sensibility of the respondent. Subsequently, the same characteristics are assumed to directly stimulate or decrease propensity toward environmentally-friendly change, directing the individual response to a given policy instrument.

4.1 Change pattern

Change patterns are presented in the tables below. It is notable that change toward a sustainable food alternative is simpler for cola drinks compared to all other products in the dataset. The reason for the high rate of change in the cola category is that the

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[15] The data used here can be found at http://hdr.undp.org/en/statistics/data.
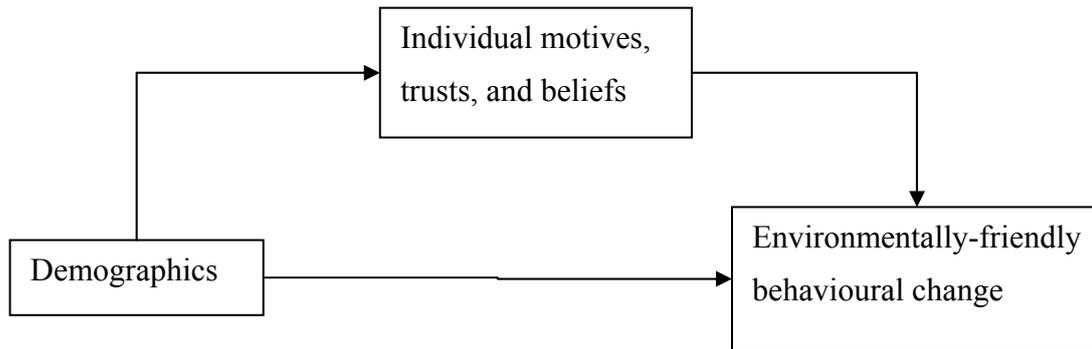
exact same product is sold in two different packages. Resistance to change largely depends on the practical aspects of packaging. These include the fact that drinks in cans are heavier to carry than plastic bottles, but easier to portion (i.e. can allow perfectly replicable amounts).

Milk is the product that shows the lowest potential for change to a more sustainable pattern. In this particular category, respondents seem to have difficulty choosing between the need for a lower caloric intake (skimmed milk) and the need for what is perceived as a better-tasting and more nutritious product (whole milk). Consumers tend to associate whole milk with taste, while skimmed milk is associated with health (Bus and Worsley, 2003). Respondents in the sample seem to be strongly attached to whole milk - namely when the household has young children. Nevertheless, all types of milk are priced equally, independent of their caloric content, making calories cheaper for whole milk compared to the alternatives (see e.g Drewnowksi and Specter, 2004, for a discussion on the price of calories). This explains the fact that whole milk is a favourite.

Change in the milk category is somehow underestimated. Here, sustainable change was considered in the decision to switch from the initial choice to the cleanest product, i.e skimmed milk. However, some respondents (21) switched from whole to semi-skimmed milk, reducing their carbon footprint by 200 CO_2 per bottle of milk. The inclusion of these individuals increases the percentage of changes to 28%.

What differentiates the milk category is the structure of changes in this product category. In fact, consumers could take a "double jump", moving from whole to skimmed milk, or opt for a smoother approach, making only a "single jump", going from whole to semi-skimmed milk, or from semi-skimmed to skimmed milk - perhaps with the intention to change further in the long-run. Due to the different characteristics of this product category, and the large number of purchases that it captured, results have been estimated separately.

The analysis of raw changes by instrument shows that ban and removal are the most effective instruments, driving over 60% of changes in all products (the only exception

being the removal treatment in milk). The tax treatment seems to be the least successful in encouraging change. This is surprising because the tax treatment offered a benefit to respondents by decreasing the relative price of the cleaner alternative. Similarly, the exogenous price change did not play a substantial role in directing change, with the exception of the Cola category

These results do not, however, allow conclusive statements. The different change pattern could be driven by other variables that are not considered in this section. For example, respondents in the different treatments may have been slightly different, and perhaps changes in choice were not caused by the treatment, but by the different demographics. Econometric techniques are used to determine the impact of each treatment; these techniques can differentiate the impact of different variables on the decision to change.

Table 3: Percentage of respondents who changed, by product and instrument[16]

	Info	Tax	Price	Ban	Removal	Total
Cola	33%	27%	59%	82%	76%	55%
Milk	9%	5%	6%	60%	47%	25%
Meat	22%	12%	15%	69%	71%	37%
Butter	24%	16%	20%	70%	79%	45%

4.2 Shopping motives

Each shopper has different motives when choosing products in a store These motives change with the demographic characteristics of the respondent, and different clusters of consumers are expected to behave differently in the marketplace. A regression analysis was performed to identify the conditional dependence of each demographic variable with each of the factors identified. This methodology identifies which factor significantly affects the mean of the population for each motive, and the coefficient tells how much each unit of the dependent variable (for instance, each unit of income) influences the social motive. In the results, the constant term indicates the average motive in the sample population, hence a predisposition (positive value) or reluctance (negative value) toward the motive in question. Results are presented in Annex 4, while a summary of the statistically significant variables is reported in tables 4 (for cola, meat and butter jointly) and 5 (for milk only).

Social motives are driven by a consumer's political stance. The importance of social motives increases in conservative and moderate labour supporters, except for the milk category, where neutral and moderate conservatives place a higher value on social motives. Social motives also increase in female consumers, who show a stronger propensity for social engagement in their food choices. While no other variable

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[16] Changes are calculated with respect to the total number of initially "dirty" purchases

influences these motives in the pooled analysis of meat, cola, and butter, the milk category reveals other factors that play an important role. For example, consumers appear to have a negative propensity toward social motives, which increases in Sikh people, and people who either rent or fully own their house, and with the factors identified earlier.

The second set of shopping motives is **health motives**. While consumers seem to be neutral regarding health issues, the importance of this factor increases for consumers with a high opportunity cost of illness. These motives increase with age, since elderly people have higher incentives to take care of their own health, and pay more attention to health signals. These motives also increase for households with many children, for respondents belonging to higher social classes, and for religious people (independent of their religion). They also increase among people who read politically neutral newspapers, such as local or free newspapers, the Times, or the Financial Times. Finally, women appear to have higher health motives in their food shopping compared to men. This motive appears to be irrelevant among milk consumers, as this factor was not identified by the factor analysis.

A third set of shopping motives are **ethical motives**. Results indicate that individuals, on average, have a propensity to put restrictions on themselves while food shopping. For most categories, the intercept is significantly positive, but this does not happen for milk consumers. The baseline level of motives increases when the consumer belongs to minority religious groups. For example, Jews, Hindus, Sikhs and Muslims were more likely to be influenced by ethical motives than Christians. In the case of milk, ethical motives decrease for non-Christian religions, and the same characterises atheists for all other products. Ethical motives also increase with the number of children in the household.

It appears that poorer households are more influenced by ethical motives. The importance of ethical motives was rated higher (in the categories of cola, meat, and butter) by younger consumers, those with low incomes, and those from lower social classes. In the case of milk, ethical motives are also higher in lower social classes, but no other economic variable is significant. In the milk market, neutral, moderate conservative, and moderate labour political positions all decrease ethical motives.

The marital status of consumers is also important in determining the level of ethics used during food shopping. Widows/widowed respondents are the least likely to be influenced by ethics. In the milk market, divorced individuals are the second least likely group to be influenced (behind widowers). In the remaining food markets, being engaged or cohabiting (in an unstructured constructive relationship) also decreases the level of ethical motives consumers use in their food shopping. Finally, graduate (but not post-graduate) education plays a negative role on ethical motives in cola, meat, and butter consumers.

The final factor identified represents **consumer motives**. This factor refers to the ability of individuals to accommodate strictly individual needs while shopping, such as personal taste and low price, and the search for brand signals. Not surprisingly, respondents with higher consumer motives are more efficient in their shopping, as they achieve the lowest cost per unit of taste. This set of motives is generally neutral, and decrease for conservative and moderate conservative individuals (the latter only

for cola, meat and butter consumers). In the case of milk, these motives increase as social class and family size (in terms of number of children) increases, and respondents from developing countries tended to have higher consumer motives. Among consumers of cola, meat and butter, consumer motives further decrease in households that fully own their home, while Sikh respondents, on average, showed less of this motive compared to the rest of the population.

Table 4. Demographic characteristics that significantly affect shopping motives – all products excluding milk

	Social Motives	Health Motives	Ethical Motives	Consumer Motives
Characteristics of people that are <u>more</u> likely to be motivated by factor	Female	Older people	Muslim	Sikh
	Conservative	Female	Hindu	
		Higher social class	Sikh	
			Jewish	
		Higher number of children		
		Conservatives		
		Political neutral		

Characteristics of people less likely to be motivated by factor	Atheists	Older people Lower incomes Lower social class People who are cohabitating/widowed/engaged Postgraduate education Atheist	Conservatives Moderate conservatives Homeowners

Table 5. Demographic characteristics that significantly affect shopping motives – milk only

	Social Motives	Ethical Motives	Consumer Motives
Characteristics of people that are more likely to be motivated by factor	Female Conservative Neutral Moderate conservative Sikh Renting Homeowners with no mortgage	Higher number of children Muslim Hindu Sikh Jewish	Higher social class Higher number of children
Characteristics of people less likely to be motivated by factor		Lower social class Divorced/widowed Politically neutral Moderate conservative Other religions	Conservative

4.3 Trust and Beliefs

This subsection applies the conceptual framework used in the analysis of shopping motives to the factors that identify beliefs about climate change and action (both individual and governmental). Again, factors have been correlated with individual characteristics of respondents to understand how demographic characteristics influence their choices. Results are presented in Annex 4, and a summary of the statistically significant variables is reported in tables 6 (for cola, meat and butter jointly) and 7 (for milk only).

The first factor, ***climate change belief***, captures how strongly people believe in the existence of climate change, and if consumers identify it as a threat to themselves and society. Cola, meat, and butter consumers appear fairly neutral on climate change (the intercept is not significantly different from zero), while milk consumers appear to have a negative propensity to believe in this phenomenon. However, belief in climate change increases as social class increases, and it is higher in women than men. Among consumers of cola, meat and butter, belief in climate change further increases if the respondent is or has been previously married (with the highest impact being that of widowed respondents), while among milk consumers, this factor increases if the respondent is cohabiting, and decreases if she/he is engaged.

In addition, moderate labour supporters show a higher belief in climate change compared to the average population. Unsubsidised home rental and ownership increases the level of belief, especially among respondents who pay a monthly fee (rent or mortgage) for their home. Among different religious groups, atheists tend to have a higher belief in climate change compared to the average population. Followers of other religions tend to believe in the problem when shopping for cola, meat and butter, while dismissing the problem when purchasing milk. Finally, among milk consumers, respondents with a graduate education tend to have a higher than average belief in climate change.

The level of trust consumers assign to themselves in dealing with environmental problems was measured by a factor named ***trust in personal responsibility***. Results show that consumers have no rational trust in the effectiveness of personal responsibility in facing climate change when in the market for cola, meat and butter, while they tend to reject this factor when shopping for milk. The average level of trust in personal responsibility is higher in women than men, and it also increases as social class increases.

When shopping for cola, meat and butter, the trust in personal responsibility increases with a postgraduate level of education, number of children, and in families headed by a married couple. Moderate labour supporters tend to have a stronger trust in individual action compared to the rest of the population, and followers of less populous religions have a stronger trust than those in larger religious groups. However, trust in personal responsibility is negatively affected by household income, indicating that poorer households have a stronger belief than richer ones. Similarly, respondents from countries with a lower level of development trust personal responsibility more than the rest of the population.

When shopping for milk, trust in personal responsibility increases in respondents living with their partner or cohabiting, and in Sikh respondents compared to people from other religions. Finally, living in unsubsidised accommodation (renting, owning with a mortgage, and full home ownership) tends to have a positive effect on the belief of the effectiveness of individual action.

The last factor considered provides a measure of the trust the respondent places in the effectiveness of governmental intervention in tackling climate change issues, or ***trust in governmental action***. Once again, results show that while the average level of trust in the government is not significantly different from zero when purchasing cola, meat and butter, consumers shopping for milk have a negative propensity for trust in the government. Women also show a stronger trust in the government than men, and this trust further increases with the number of children in the household.

Among people purchasing cola, meat, and butter, trust in government increases with social status. In addition, moderate labour supporters are the most trusting compared to all other political stances. Individuals who have or have had their marital status regulated (such as being married or divorced/separated) have a stronger trust in government, and those who have been divorced/separated have the most trust. Finally, Muslims and followers of other religions have a higher level of trust in governmental action.

In the milk market, trust in governmental action is higher among Muslim and Sikh consumers (with the highest propensity among Sikhs). Finally, individuals living in unsubsidised accommodation (renting, owning with a mortgage, and full home ownership) are more likely to believe in the effectiveness of governmental intervention.

Table 6. Demographic characteristics that significantly affect trust and beliefs – all products excluding milk

	Climate Change Belief	Feelings of personal responsibility	Trust in governmental responsibility
Characteristics of people that are <u>more</u> likely to be motivated by factor	Female Higher social class Divorced/separated Widowed Atheist	Female Higher social class Higher number of children Married Postgraduate education	Female Higher social class Higher number of children Married/divorced/separated Muslim Other religions
Characteristics of people <u>less</u> likely to be motivated by factor		Lower income No religion reported	No religion reported

Table 7. Demographic characteristics that significantly affect trust and beliefs – milk only

	Climate Change Belief	Feelings of personal responsibility	Trust in governmental responsibility
Characteristics of people that are <u>more</u> likely to be motivated by factor	Female Higher social class Cohabitating Postgraduate education Atheist Renting Owning with mortgage	Female Higher social class Cohabitating Sikh Renting Owning with mortgage Full home ownership	Female Higher number of children Muslim Sikh
Characteristics of people <u>less</u> likely to be motivated by factor	Engaged Other religions		No religion reported

4.4 Link between Policy Instruments, Demographic Characteristics, and Dietary Change

A connection between consumers and their choices can be extracted after establishing a link between demographic characteristics and factors. It is important to see how beliefs and motives influence individuals towards choosing more sustainable food products. The focus of this analysis is to establish how consumers react to different policy instruments, and how demographic characteristics influence the process of sustainable change. For this analysis, the same model is used, both including and excluding demographic information, to compare the effect of demographics on the proposed mode. The factors included in the regression are the same as those presented in the previous section, and only initial polluters are included in the estimation. Results of the logistic regression are reported in Annex 5, while a summary of the significant variables and their sign is included in Table 8.

Instruments are measured relative to the exogenous price change scenario, which is then used as a reference in the results. This baseline scenario represents the situation in which change toward sustainable consumption is obtained "naturally", with no external influence; change occurred because the cleaner product alternatives became cheaper to produce than less environmentally friendly options. Consequently, the intercept of the model indicates the individual propensity toward change, and it represents a situation where consumers would switch following a "natural" change in

production costs in the market for cola (when cola, meat, and butter are pooled), or milk (in its specific regression).

In general, environmental economics predicts that the individual response to environmental problems, such as climate change, depends on the belief in climate change and its negative consequences (Kaiser et al., 1999). Individual action is then expected to be positively correlated with a belief in the importance of personal responsibility in dealing with the problem (Straughan and Roberts, 1999), and is higher for those who shop with social motives in mind (Kaiser et al., 1999). The impact of individual trust in governmental action is less straightforward. In general, individuals with high levels of trust are expected to favour change toward a more sustainable food product, on the assumption that the government intervenes successfully whenever there is a real threat to the country (assuming climate change is perceived as one). On the other hand, individuals with higher trust in governmental action would be expected to act only when governmental regulation is in place and they are made aware of it. They would also be expected to change food choices less frequently in exogenous scenarios and in the presence of a label.

Results indicate that consumers tend to resist changes in food consumption when demographics are excluded, as the intercept is significantly negative. However, in the cola, meat and butter market, this effect disappears after the inclusion of demographic characteristics, indicating that personal taste is what drives the baseline resistance; the intercept remains significantly negative in the milk regression. The cola category has the highest propensity for change, while dummies for all other products indicate a significantly strong resistance. This is not surprising, since the market for cola involved a choice of packaging, not of product, while consumers of milk, beef, and butter had to change their shopping objectives to improve their level of sustainability.

One unexpected result is that the presentation of information on climate change did not influence choice or encourage change, except in milk.[17] This is difficult to explain in practical terms. The irrelevance of information could be a case of "wilful ignorance" (Ehrich and Irwin, 2005); consumers who are interested in the environmental problem refrain from reading the information because it would cause stress and complicate their shopping excursion. Stress would arise because they might learn that their favourite choice is the "dirty option" and that they should refrain from purchasing it. However, when tested (results not included), we found that consumption of environmental information is higher in people that lend greater importance to social motives while food shopping.

Another possibility is that individuals who are already aware of carbon emission issues did not learn anything new from the information. A last, and very likely, factor is that individuals with more social awareness read the information, but failed to allow it to affect their shopping choices, because they feel that they are already aware of the problem (i.e. they feel they look for enough environmental quality signals in the market). Their attention to, and awareness of, the problem implies that they seldom shop for the polluting alternative (i.e. beef or butter), and when they do shop for these

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[17] A fact that might have played a role is that in the environmental information, an explanation of carbon footprint labelling was done using the real milk label as an example. This might have provided a stimulus to consumers in the milk market, whilst not in the remaining markets.

choices, they genuinely feel they cannot avoid it. This decreases their likelihood of change; perhaps the provision of information decreased the amount of product purchased, but not the type.

The coefficients of the treatment variable clearly indicate that consumers' response to different policy instruments differs sensibly, compared to the exogenous price change scenario. Unsurprisingly, product ban and removal are the most effective tools to induce change toward sustainable consumption. The lack of availability of the requested item forces a large number of consumers to opt for the alternative good, with an increase of 700-800% (for cola, meat and butter), to over 1000%-2000% (in the case of milk). However, a ban is a difficult instrument to implement in certain markets. According to these results, quantity restrictions are more effective for milk, and are easily implementable for cola, where choice consists of a difference of packaging.

The impact of the ban is not as large as expected. In theory, the absence of the most polluting alternative would prompt all consumers to change to the less polluting option because it would be the only option available. However, in the experiment, only some consumers actually changed to the less polluting option when the dirtier option was not supplied; perhaps other respondents realized they could purchase it at another store. If respondents took the ban seriously, they would purchase the banned good in an illegal market. Further results (not included in this work) indicate that response to a ban is not significantly different from that of an exogenous product removal.

In the sample, the labelling scenario is not significantly different from the exogenous price change, which consists of a scenario that indicates a "natural" cost adjustment favouring more sustainable food consumption. The insignificant difference between these two scenarios indicates that labelling could be an effective way to achieve sustainable objectives with the least interference in the market. The use of only private capital, under governmental regulation, can stimulate the market to an exogenous adjustment toward improvements in the sustainability of food consumption.

Finally, taxation has a negative impact on change among consumers of cola, meat, and butter after adjusting for a belief in the government and in climate change. Consequently, the use of an environmental subsidy tends to "crowd out" intrinsic motivations (consistent with Goeschl and Perino, 2009), making consumers less prone to change. This is surprising, as a subsidy aims to decrease the relative price of the cleaner alternative in the market. Failure to accept governmental price intervention may be due to consumers disliking the use of governmental revenue to regulate the market directly, while preferring alternative, less invasive, solutions. It should be stated that this result does not depend on individual belief in climate change, or on trust in governmental action, as these two factors have been accounted for in the regression.

The role of motives and beliefs in the action of respondents is generally low. Ethical motives play a significantly positive role in driving change when shopping for cola, meat and butter. Only individuals who give importance to religion, vegetarianism, and preparation time tend to change more easily than the rest of the sample. Consumer

motives become important in the milk market, stimulating change; however, this significance disappears when demographic characteristics are included, suggesting that this factor is driven by demographic variables.

A belief in the existence of climate change and a trust in personal or governmental responsibility in tackling carbon emissions appears to have no impact on change. This result is contrary to expectation, particularly for individuals with a higher trust in personal responsibility in dealing with climate change. These people are generally expected to take direct action to tackle environmental problems. Again, this is a feature of the theory of "wilful ignorance" (Ehrich and Irwin, 2005), which states that individuals, who are otherwise willing to act, actually fail to do anything because they refuse to access information they find interesting. This is due to a fear that the information would expose negative aspects of their favourite products.

Personal and household characteristics play a different role depending on the market. In the market for cola, meat, and butter, only social class is a significant factor, with a negative coefficient indicating that sustainable change increases as social class decreases. Consequently, lower social classes tend to be more likely to change, compared to higher social classes. This is probably because lower classes receive a higher benefit from environmentally-friendly goods due to lower access, so they have larger incentives than higher classes. No remaining factor has a significant role in determining change. The only surprise occurred when examining the coefficient of income. This variable was expected to be significantly positive, with lower income households less likely to change, as environmentally-friendly goods are not necessary. The failure to see any significance in this variable could be due to the presence of the £5 voucher, which consumers probably added to their overall shopping budget, even though they only received it after completing their shopping trip.

Change is also conditional on the political stance of the respondent. Compared to radical political views, including supporters of both the labour and conservative parties, only moderate respondents (both labour and conservatives) have a significantly positive impact on change. They identify the positive and important role of the media in supplying information and conveying social values to readers. Finally, the location of the survey indicated heterogeneity in the propensity to change: compared to Walthamstow and Merton, all other locations had a significant resistance to change, showing lower change rates.

In the milk category, income becomes an important negative factor: high-income households appear to change less often than low-income ones. As mentioned earlier, this is not an intuitive finding, as the expectation would be that consumption of any environmental good would actually increase with income. However, the negative coefficient could be due again to the fact that poorer households place more value on the environmental good (they might not own a garden, for instance), and they are more willing to change.

The most important demographic barrier to change in the milk market is the perceived better performance of whole milk in young children. This is supported by the fact that female respondents are generally less likely to switch products. Many of them were mothers, and stated the nutritional significance of their originally intended purchase. The importance of this product for children is confirmed by the negative effect of the

number of children on change: the more children are in a family, the less likely the household is to purchase skimmed milk.

5 Discussion

Consumption of food and agricultural goods constitutes an important part of household consumption and GHG emissions. Consequently, current research suggests that policies aiming to improve sustainable development should address dietary change at household level.

This paper addresses the issue of finding the best policy instrument to address dietary change to reduce households' GHG emissions. It addresses the importance of approaching carbon neutrality at the individual household level, trying to understand how consumers can be encouraged to choose environmentally friendly food alternatives during their usual shopping trip. The experimental consumer policy used to achieve dietary change focuses on three alternative instruments:

1. Labelling, which increases the level of knowledge about the product, allowing consumers to include the environmental information in their utility function;

2. Price instruments, which evaluate the social costs of GHG emissions caused by different food products, and add the extra cost to the price of the good;

3. Quantity instruments, which removing the cause of pollution from the market (i.e. the environmentally unfriendly alternative), therefore reducing the environmental burden caused by food shopping.

This paper empirically tests whether the choice of these three instruments is independent on outcome (Cooter, 1984), or whether consumers can be effectively directed towards cleaner food alternatives, preferring one instrument over the others. The paper also explores whether consumers are able to use environmental information when provided, and whether shopping motives, belief in climate change, and trust in personal or governmental action help consumers to improve their climate friendliness.

Unsurprisingly, results indicate that the most effective policies are those that completely remove the polluting alternative, as the consumer is forced to seek alternatives when their first choice is not available. The presence of a ban or a removal, however, is not dramatic enough to deter consumers from purchasing a product; the use of such instruments would facilitate the creation of illegal sources (black markets) of the prohibited good, casting doubts on the economic viability of such a policy instrument (see also Becker et al., 2006). In addition, some respondents who were presented with bans or removals expressed discontent in the "comment" box. This mainly occurred when the government was responsible for the change, making a ban or removal politically difficult to implement in real life. Bans and removal would also not constitute "nudges," in the sense that they did not leave the consumer the choice to pick the banned alternatives.

The use of a price instrument (in the form of a subsidy) to decrease the relative cost of the cleaner alternative proved ineffective, since consumers tended to either crowd out when this scenario was in place (when purchasing cola, meat, and butter), or ignore it (in the case of milk). Compared to an exogenous price change, a subsidy scheme revealed a negative effect on dietary change, indicating that consumers dislike a price regulation to internalise environmental externalities. This is consistent with previous research that indicates that price regulation crowds out intrinsic motivations, while quantity regulation does not (Goeschl and Perino, 2009).

The last instrument included in the experiment is a labelling scenario. This case indicates a condition in which the market uses private capital (from the manufacturer) to adjust and incorporate the environmental information on the label of the product sold. This scenario is not significantly different from "natural" market adjustment, or the exogenous price change scenario. Consequently, it would appear that the use of labelling, and the use of private resources to incorporate the externality, would successfully replicate a natural adjustment. This would make labelling the most successful instrument among those tested in the experiment presented here.

5.1 How and when people are nudged

The idea behind nudges- that people should be presented choices that represent their best interests- implies that any nudge situation should be constructed to carefully display the best options. The experiment shows certain nudges are more effective than others. For example, results indicate that sustainable change is easier for easily substitutable products. When alternatives differ only in their packaging (as in the case of cola) sustainable dietary improvements can be achieved more successfully, mainly because the product does not change. When two products are not seen as close substitutes, such as beef and chicken (Fraser and Moosa, 2002), consumers find it more difficult to switch, even if they know this would benefit the environment.

A surprising finding is that consumers who accessed the environmental information provided did not necessarily change their preferences, except in the case of milk. There are two possible explanations for this result: (1) wilful ignorance (Ehrich and Irwin, 2005) where consumers, who are otherwise interested in environmental information, refrained from reading it to avoid seeing unpleasant information about their food choices; or (2) the fact that those consumers who could potentially be swayed by the information were already aware of the issues. Since the first option was tested and rejected, the second is more likely to be true.

A further unexpected finding came from the analysis of shopping motives, the belief in climate change, and the trust in individual and governmental responsibility. This set of factors seems to play a minimal role in the determination of change. However, ethical motives seem to play a positive role in the market for cola, meat, and butter, while consumer motives might have some influence in the milk market. Social motives, the belief in climate change, and trusts have no effect on change, indicating that these factors have no influence on consumers' choices in the presence of an environmental problem.

The limitations of an experiment, however, may hide some important considerations. The experiment captures a single choice, and it is not able to observe changes

occurring at a different level in the utility function of a consumer. For example, it appears very likely that individuals with higher social motives and support for the environment would not only change their choice of product on occasion, but might also prefer to reduce the total quantity of environmentally unfriendly food they purchase, or to buy it less frequently. This is supported by the fact that social motives include a large set of quality signals; consumers might feel they already take enough care of the environment in their choices, which are infrequent, and when they buy the relatively unfriendly product, they are not easily persuaded to change. Finally, the large amount of information given to consumers may make it difficult to decipher what is new information to them. Perhaps an increase in familiarity with environmental information could yield benefits in the longer-term. On this last point, it is worth highlighting that Sainsbury's does not use a carbon label on its own products, and the general level of consumer familiarity with such labels in the UK is still relatively low (Upham et al., 2010).

The results presented in this experiment show that demographic characteristics play a double role in the presence of environmental problems. First, demographic characteristics shape personal factors such as beliefs, trusts, and shopping motives. These factors may directly influence the personal decision to pursue a more sustainable food choice. However, experiment results indicate that their role is actually minimal. Second, demographics also influence the final decision to change, directly influencing the final outcome of the policy.

The importance of demographic information in improving the sustainability of food choices depends on the market in consideration. For cola, meat, and butter, higher social class negatively affects change, while moderate labour, moderate conservative, and politically neutral respondents tend to change more often than the average respondent. In the milk market, the importance of the perceived nutritional benefits of whole milk is shown by the reluctance of women to change, particularly in households with a larger number of children, while income is negatively correlated to change.

5.2 Effect on Future Policies

The overall conclusion of this work is that policies aiming to improve sustainability in food consumption through nudges need to be constructed in a way that targets the many different characteristics of consumers. A positive response to a policy instrument depends on the characteristic of the target: who he or she is, and how interested he/she is in addressing social problems, a factor which, in itself, is a function of these demographic variables. Individuals appear to not always be socially attentive, and the propensity to act tends also to be negative. Furthermore, a policy that focuses on providing information that requires personal initiative is probably going to be ineffective in fostering change. However, it could potentially be beneficial if it was made available to every consumer (e.g. in the label). Policies that are carefully tailored to consumers, such as social marketing, could increase sensitivity and improve sustainability in different groups of consumers.

One final consideration is that a single-policy instrument is not recommended. The results presented here indicate that different instruments achieve different result, and target different consumers. Therefore, it would be beneficial to use a combination of

instruments rather than a single one. A variety of instruments could reduce sustainable consumption of different clusters of consumers, obtaining a synergic effect that would achieve sustainability at a faster pace. For example, a ban that targets packaging could reduce the amount of cans. Similarly, reducing the availability of whole milk would be simpler than doing the same for beef. Consequently, a targeted policy mix would be more effective at reducing the quantity of GHG emissions produced by households than the use of a single policy instrument. However, further research is needed to understand how different instruments affect not only choice, but also quantity purchased and shopping frequency, and to provide a better understanding of the link between information and choice.

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Acknowledgements

Annex 1: Econometric model

Imagine a market where individual *j* faces a choice of *n* different alternative products. In evaluating costs and benefits of all the options, consumer *j* will make use of his utility function in the form

$$U_{ij} = f(X_i, P_i, D_j)$$ Equation 1

where X_i are the characteristics of the product, P_i its price, and D_j are household-specific demand shifters that proxy consumption. Assuming utility to be linear in its parameters, equation (1) can be written in the form

$$U_{ij}^1 = \beta_0 + \beta_1 X_i + \beta_2 P_i + \beta_3 D_j$$ Equation 2

Now suppose consumers belong to a homogeneous group of polluters. To curb the level of pollution, the government intervenes in the market to implement a new stricter regulation on household consumption. This legislation, say T_i, inevitably imposes a barrier to the utility function of polluters presented in equation (2), which becomes

$$U_{ij}^2 = \beta_0 + \beta_1 X_i + \beta_2 P_i + \beta_3 D_j + \beta_4 T_i$$ Equation 3

The effect of the newly imposed barrier is to disfavour the choice of the most polluting alternative, increasing the relative utility of the cleaner product in the bundle, or decreasing the utility of the targeted products. This can be observed from the behaviour of consumers, who tend to switch away from a polluting to a clean alternative when the instrument is in place.

The effectiveness of the instrument targeting product *i* interfering with the decisional process of consumer *j*, E_{ij}^*, can then be defined as a latent construct; it is not observable, but it becomes evident when a polluter shows a change toward a cleaner alternative. Accordingly, a positive policy outcome can be identified by a variable E_{ij}, which assumes the value of 1 whenever the initial polluter purchases a cleaner alternative, and 0 otherwise. Specifically, this can be written as

$$E_{ij} = 1 \quad if \quad E_{ij}^* > 0$$
$$or$$ Equation 4
$$E_{ij} = 0 \quad if \quad E_{ij}^* \leq 0$$

The effectiveness of a policy can then be modelled as

$$E_{ij} = \alpha_0 + \alpha_1 D_j + \alpha_2 T_i$$ Equation 5

The connection between equation 3 and 5 can be easily established. Essentially, the efficacy of the policy instrument estimates an utility function for the more sustainable food alternative amongst initial polluters, or

$$E_{ij} = U_{ij}^2 = f(X_i, P_i, D_j, T_i \mid U_{ij}^1 = 1)$$ Equation 6

Annex 2: Results of the Principal Component Analysis (PCA)

As mentioned in section 3, the experiment contained a series of questions to identify the importance to respondents of a set of 18 signals commonly found on food labels. These can be found in table A1. Respondents were asked to rate the level of importance they attached to each signal on a 5-points likert scale. Subsequently, these 18 dimensions were reduced using a Principal Component Analysis[18] (PCA). The exact number of factors was determined setting a unit Eigenvalue as a cut-off point, and factors were rotated using a Varimax rotation in order to make them orthogonal.

The results, reported in table A1 and A2, for all products excluding milk, and milk alone, can be summarised in the identification of four shopping motives, described below:

1. *Social motives*: these indicate the level at which the individual searches for socially and environmentally distinctive signals, such as fair trade labels, environmentally friendly packaging, animal welfare, organic, country/locality of origin, seasonality (low food miles), etc.

2. *Health motives*: these indicate how important health signals are in the choices of food the individual makes. These signals include low-fat, low-salt, and high fibre products, as well as food with special dietary recommendations. Separate results (not included in this work) indicate that health motives are particularly important in the choice of meat and butter, essentially because these categories have been exposed to safety (e.g. mad cow disease, salmonellosis) and nutritional (e.g. saturated fat content) problems in the past. Consumers of milk in the sample in analysis do not appear to make use of this motive in their shopping.

3. *Ethical motives*: these represent the importance of ethical constraints such as vegetarianism and religion, and have a high opportunity cost of cooking, i.e. a time barrier.

4. *Consumer motives*: theseindicate the degree of importance given to personal taste, low price, and recognisable brands in the choice of food made by the consumer.

Table A1.   Factor loadings for all products categories excluding milk

	Motives			
	Social	Health	Ethical	Consumer
Animal welfare	0.773			
Recognisable brand				0.552
Country of Origin	0.608			
Fair trade	0.673			
Low fat		0.740		
Low salt		0.808		
Organic	0.626			

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[18] The PCA was performed only on those individuals who purchased the environmentally unfriendly option in the first instance, i.e. the sample of respondents included in the final analysis.

Local	0.728		
Vegetarian		0.682	
Low price			0.709
Low preparation time		0.532	
Seasonality	0.589		
Religion		0.832	
Personal taste			0.736
Dietary recommendations		0.602	
Recyclable packaging	0.639		
High fiber content		0.704	
Fair price for farming	0.696		

Extraction method: Principal Component Analysis
Rotation method: Varimax with Kaiser normalisation
Note: only values over 0.5 are reported in the table

Table A2.   Factor loadings for all products categories – milk only

	Motives		
	Social	Ethical	Consumer
Animal welfare	0.769		
Recognisable brand			
Country of Origin	0.645		
Fair trade	0.738		
Low fat			0.582
Low salt			
Organic	0.601		
Local	0.707		
Vegetarian		0.643	
Low price			0.739
Low time of preparation		0.622	
Seasonality	0.601		
Religion		0.827	
Personal taste			0.726
Dietary recommendations			
Recyclable packaging	0.720		
High fibre content			
Fair price for farming	0.746		

Extraction method: Principal Component Analysis
Rotation method: Varimax with Kaiser normalisation
Note: only values over 0.5 are reported in the table

PCA was then used to identify three other factors: personal belief in climate change and its consequences, and governmental and individual responsibility in dealing with climate change. Here, respondents were presented with a list of 11 statements

relating to these three areas, and asked to report their level of agreement on a 5-point likert scale. Tables A3 and A4 report the actual sentences presented to participants, and the results. The three factors are:

1. *Climate change belief* (statements 1-4): how strongly the person believes in the existence of climate change, and its negative consequences;
2. *Trust in personal responsibility* (statements 5-9): how strongly the person supports the importance of personal action and responsibility in tackling climate change;
3. *Trust in Government responsibility* (statements 10-11): how strongly the person believes the government is able to successfully intervene and limit the impact of climate change.

Because these three factors have been estimated individually, they have not been rotated, and they are not orthogonal.

Table A3. Factor loadings for all products categories excluding milk

	Trust/belief		
	Climate change	Personal responsibility	Government responsibility
Climate change is a dangerous global threat	0.8854		
Humans are responsible for climate change	0.8799		
Britain should keep trying to combat climate change, even if other countries do not do so and sometimes cancel out what we do.	0.9083		
The effects of climate change worry me, even if their impact is far in the future.	0.8960		
Its worth me doing things to help the environment even if others dont do the same.		0.8868	
Care for the environment has a high priority compared to other things in my life.		0.8506	
I believe my everyday behaviour and lifestyle can contribute to climate change.		0.8651	
It is worth being environmentally friendly even if this does not save you money.		0.8639	
People have a duty to recycle.		0.8510	
The government will take the correct action to support climate change mitigation, if there is adequate information to support that policy.			0.8973
Government intervention is the most effective option to combat social problems such as climate change.			0.8973

Extraction method: Principal Component Analysis
Note: since factors have been estimated individually, the resulting factor loadings have not been rotated.

Table A4.   Factor loadings for milk

	Trust/belief		
	Climate change	Personal responsibility	Government responsibility
Climate change is a dangerous global threat	0.903		
Humans are responsible for climate change	0.891		
Britain should keep trying to combat climate change, even if other countries do not do so and sometimes cancel out what we do.	0.905		
The effects of climate change worry me, even if their impact is far in the future.	0.890		
Its worth me doing things to help the environment even if others dont do the same.		0.890	
Care for the environment has a high priority compared to other things in my life.		0.845	
I believe my everyday behaviour and lifestyle can contribute to climate change.		0.858	
It is worth being environmentally friendly even if this does not save you money.		0.880	
People have a duty to recycle.		0.854	
The government will take the correct action to support climate change mitigation, if there is adequate information to support that policy.			0.886
Government intervention is the most effective option to combat social problems such as climate change.			0.886

Extraction method: Principal Component Analysis
Note: since factors have been estimated individually, the resulting factor loadings have not been rotated.

Annex 3: Variables included in the econometric model

The variables included in all the regressions included in this work are described in table B1. Further detail on the source of the data can be found in section 3.

Table B1.   **Definition of the variables**

	Variable name	Description
Problem	Climate change believer	Individual believes in **climate change** and need for action
Responsibility	Trust in personal responsibility	Individual believes in the importance of **personal** responsibility in tackling climate change
	Trust in governmental responsibility	Individual believes in the ability of the **government** to tackle climate change
Motives	Social motive	Individual shops for food looking for social signals
	Health motives	Individual shops for food looking for health signals
	Ethical motives	Individual shops for food looking for ethical (and time) information
	Consumer motives	Individual shops for food looking for value-for-money and brand
Information provided	Environmental information	Individual asked to view the environmental information provided
Demographic information of the respondent	Intercept	Constant term of the function.
	Age	Age of the respondent.
	ln (income)	Natural log of household yearly income.
	No income	No income reported.
	male	Gender dummy, equalling 1 for male, 0 for female.
	HDI	Human development index (relative to year 2007) of the country of origin of the respondent.
	Social class	Social class, going from 1(lowest) to 15 (highest social class).
	Nr of children	Children in the household.
	Marital status	Set of dummies indicating the marital status of the respondent. These include: Single; Married; Living with partner or cohabiting; Divorced/separated; Widowed; Engaged; Generic relationship
	Political stance (derived from	Newspaper purchased, grouped by political support. This set of dummies included: radical conservatives

	Newspaper readership[19])	and labourists (tabloids: Mail, Express, Sun, Star); conservative (Telegraph); Neutral (locals, freebies); moderate conservatives (Times, FT); moderate labourists (Guardian, Independent, Mirror).
	Education	Level of education of the respondent, including: Non-university education; University level education (including BSc equivalent qualifications), Postgraduate level education
	Religion	Series of summy variables describing the religion of the respondent. The option included Muslim; Jews; Christians; Hindu; Sikh; Buddhists; others; atheists; and no religion reported.
	Home ownership	The option included: subsidised rent (including young people living with parents); full rent of property; ownership with outstanding mortgage; full ownership of property.

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19 Newspapers have been grouped in accordance with an existing survey on the political stance of newspaper carried on by a private market research company. Results can be found in http://www.ipsos-mori.com/researchpublications/researcharchive/poll.aspx?oItemId=580&view=wide. Mail, Express, Sun, and Star have been included in the same category independently on their political view, because of their format (these are tabloid journal, rather than more classical newspapers). This categorisation also found academic support in Brandenburg (2006).

This annex presents the results of the regression analysis that correlated demographic characteristics to the factors obtained from the PCA presented in the previous annex. The econometric model used is that of the Seemingly Unrelated Regression. This methodology simultaneously estimates the system of multiple regressions, also calculating the correlation between the equations in the same system.

Results of the SUR model for shopping motives are presented in table C1 (for cola, meat, and butter) and C2 (for milk). In both tables, results indicate that shopping motives are not correlated among each other, and this is because all factors had been rotated orthogonally in the PCA, eliminating the correlation.

Results of the same SUR for beliefs and trust are presented in table C3 (for cola, meat, and butter) and C4 (for milk). Since these factors have been estimated using a PCA independently, they could not be orthogonalised, and the results report a significantly positive correlation of the residuals of the three equations. This means that the three factors are simultaneously determined, and the increase in a single factor stimulates the increase of the other factors at the same time.

A detailed description of the results is reported in the main text of this report.

Table C1.   Demographic factors influencing shopping motives – all product excluding milk

		Social motives		Health motives		Ethical motives		Consumer motives	
		Coefficient	S. E.	Coefficient	S. E.	Coefficient	S. E.	Coefficient	S. E.
Personal and household characteristics	Intercept					1.1607**	0.5031		
	Age			0.0146***	0.0039	-0.0063*	0.0036		
	ln (income)					-0.1061*	0.0608		
	No income								
	Male	-0.1594**	0.0810	-0.2528***	0.0798				
	HDI								
	Social status			0.0268***	0.0105	-0.0171*	0.0098		
	Nr of children			0.1475***	0.0401	0.1110***	0.0377		
Marital status	Single	Reference		Reference		Reference		Reference	
	Married								
	Living with partner, cohabiting					-0.3815*	0.2282		
	Divorced/separated								
	Widowed					-1.3732**	0.4271		
	Engaged					-0.8848*	0.5231		
	Generic relationship								
Newspaper readership	Mail, Express, Sun, Star	Reference		Reference		Reference		Reference	
	Telegraph	0.4232**	0.2050					-0.5913***	0.202
	Neutral			0.1801*	0.0982				
	Times, FT			0.2287*	0.1371			-0.2912**	0.137
	Guardian, Mirror,	0.4156***	0.1148						

Education									
	Independent								
Education	Non-university	Reference		Reference		Reference		Reference	
	Graduate					-0.2233**	0.0897		
	Postgraduate								
Religion	Christian	Reference		Reference		Reference		Reference	
	Muslim					0.8445***	0.1396		
	Hindu					0.5948***	0.1848		
	Sikh					0.7583***	0.2944	-0.5316*	0.313
	Jewish					0.3785**	0.1778		
	Buddhist								
	None			-0.1671*	0.0911	-0.2374***	0.0855		
	Other religions								
	No information provided							-0.9910***	0.376
Home ownership	Subsidised rent	Reference		Reference		Reference		Reference	
	Full rent								
	Own w/mortgage								
	Full ownership							-0.7308**	0.366
Variance-covariance matrix of the residuals	Social motives	1							
	Health motives	-0.0152		1					
	Ethical motives	0.0518		-0.0195		1			
	Consumer motives	-0.0127		-0.0142		-0.0017		1	
	Observations	652		652		652		652	
	RMSE	0.962		0.9474		0.8893		0.9482	
	R^2	0.0728		0.1008		0.2075		0.0997	
	chi^2	51.18***		73.07***		170.73***		72.24***	

Note: *, ***, *** indicate significance at 10%, 55, and 1% respectively. Missing coefficients are not significantly different from 0 at 10% of probability or less.
Breusch-Pagan test of independence: chi^2 (6) = 2.39; Pr = 0.8811.

Table C2.   Demographic factors influencing shopping motives – milk

		Social motives		Ethical motives		Consumer motives	
		Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Personal and household characteristics	Intercept	-1.1389**	0.5013				
	Age						
	ln (income)						
	No income			0.1816*	0.0942		
	Male	-0.1708**	0.0770				
	HDI					-0.8545**	0.3721
	Social status			-0.0193**	0.0092	0.0329***	0.0104
	Nr of children			0.1280***	0.0344	0.0735*	0.0388
Marital status	Single	Reference		Reference		Reference	
	Married						
	Living with partner, cohabiting						
	Divorced/separated			-0.4455*	0.2349		
	Widowed			-0.8939**	0.3679		
	Engaged						
	Generic relationship						
Political stance	Radical labourist/conservative	Reference		Reference		Reference	
	Conservative	0.4758**	0.1970			-0.4306**	0.1994
	Neutral	0.2028**	0.0958	-0.2122***	0.0858		
	Moderate	0.3457***	0.1325	-0.2376***	0.1187		

		Coefficient	S. E.	Coefficient	S. E.	Coefficient	S. E.
	conservative						
	Moderate labourist	0.3351***	0.1049	-0.2340***	0.0940		
Education	Non-university	Reference		Reference		Reference	
	Graduate						
	Postgraduate						
Religion	Christian	Reference		Reference		Reference	
	Muslim			1.1284***	0.1279		
	Hindu			0.6888***	0.1474		
	Sikh	0.7256*	0.3784	0.9109***	0.3389		
	Jewish			0.5043***	0.1505		
	Buddhist						
	None						
	Other religions			-0.8521*	0.4435		
	No information provided						
Home ownership	Subsidised rent	Reference		Reference		Reference	
	Full rent	0.4924*	0.2886				
	Own w/mortgage						
	Full ownership	0.5230*	0.3029				
Variance-covariance matrix of the residuals	Social motives	1					
	Ethical motives	0.0497		1			
	Consumer motives	-0.0054		0.0164		1	
Regression diagnostics	Observations	725		725		725	
	RMSE	0.9636		0.8631		0.9750	
	R^2	0.0696		0.2540		0.0477	
	Chi^2	54.23***		246.81***		36.33	

Note: *, ***, *** indicate significance at 10%, 5%, and 1% respectively. Missing coefficients are not significantly different from 0 at 10% of probability or less. Breusch-Pagan test of independence: $chi^2 (3) = 2.01$; $Pr = 0.5706$.

Table C3.   Demographic factors influencing trust and beliefs – all products excluding milk

		Climate change believer		Trust in personal responsibility		Trust in governmental responsibility	
		Coefficient	S. E.	Coefficient	S. E.	Coefficient	S. E.
Personal and household characteristics	Intercept						
	age						
	ln (income)			-0.1249*	0.0639		
	No income						
	Male	-0.3018***	0.0772	-0.2839***	0.0786	-0.2999***	0.0775
	HDI			-0.5996*	0.3613		
	Social class	0.0344***	0.0101	0.0324***	0.0103	0.0318***	0.0102
	Nr of children			0.0755*	0.0395	0.0756*	0.0390
Marital status	Single	Reference		Reference		Reference	
	Married	0.2015**	0.0883	0.1695*	0.0900	0.1480*	0.0887
	Living with partner, cohabiting						
	Divorced/separated	0.4718**	0.2385			0.5462**	0.2396
	Widowed	0.7931*	0.4403				
	Engaged						
	Generic relationship						

		Climate change believer		Trust in personal responsibility		Trust in governmental responsibility	
Newspaper readership	Mail, Express, Sun, Star	Reference		Reference		Reference	
	Telegraph						
	Neutral						
	Times, FT						
	Guardian, Mirror, Independent	0.3643***	0.1094	0.3567***	0.1115	0.4094***	0.1099
Education	Non-university Graduate	Reference		Reference		Reference	
	Postgraduate			0.1906*	0.1160		
Religion	Christian	Reference		Reference		Reference	
	Muslim					0.2947**	0.1445
	Hindu						
	Sikh						
	Jewish						
	Buddhist						
	None	0.1753**	0.0881				
	Other religions	1.3520**	0.6845	1.2194*	0.6974	1.2314*	0.6875
	Prefer not to answer			-0.6923*	0.3704	-0.7888**	0.3651
Home ownership	Subsidised rent	Reference		Reference		Reference	
	Full rent	1.0283***	0.3494				
	Own w/mortgage	0.8719**	0.3548				
	Full ownership	0.5867*	0.3539				
Variance-covariance matrix of the residuals	Climate change believer	1					
	Trust in personal responsibility	0.8519		1			
	Trust in governmental responsibility	0.7404		0.6771		1	
	Observations	652		652		652	
	RMSE	0.9166		0.9339		0.9207	
	R^2	0.1582		0.1253		0.1502	
	chi^2	122.49***		93.41***		115.25***	

Note: *, ***, *** indicate significance at 10%, 5%, and 1% respectively. Missing coefficients are not significantly different from 0 at 10% of probability or less
Breusch-Pagan test of independence: chi^2 (3) = 1129.51; Pr = 0.0000.

Table C4.   Demographic factors influencing trust and beliefs – milk

		Climate change believer		Trust in personal responsibility		Trust in governmental responsibility	
		Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Personal and household characteristics	Intercept	-0.9667**	0.4933	-0.8827*	0.5006	-0.8861*	0.4986
	Age						
	ln (income)						
	No income						
	Male	-0.2655***	0.0757	-0.2617***	0.0768	-0.2295***	0.0765
	HDI						
	Social status	0.0175*	0.0101	0.0218**	0.0103		
	Nr of children					0.0783**	0.0382
Marital status	Single	Reference		Reference		Reference	

Category		Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
	Married						
	Living with partner, cohabiting	0.3741**	0.1897	0.3444*	0.1925		
	Divorced/separated						
	Widowed						
	Engaged	-0.6574*	0.3939				
	Generic relationship						
Political stance	Radical labourist/conservative	Reference		Reference		Reference	
	Conservative						
	Neutral						
	Moderate conservative						
	Moderate labourist	0.2800***	0.1032				
Education	Non-university	Reference		Reference		Reference	
	Graduate	0.1506*	0.0884				
	Postgraduate						
Religion	Christian	Reference		Reference		Reference	
	Muslim					0.3401**	0.1421
	Hindu						
	Sikh			0.7132*	0.3778	0.7417**	0.3763
	Jewish						
	Buddhist						
	None	0.1531*	0.0870				
	Other religions	-0.9002*	0.4873				
	No information provided					-0.8054**	0.3487
Home ownership	Subsidised rent	Reference		Reference		Reference	
	Full rent	0.9870***	0.2840	0.7116**	0.2882	1.0074***	0.2870
	Own w/mortgage	0.8710***	0.2909	0.6142**	0.2952	0.9366***	0.2940
	Full ownership	0.8613***	0.2981	0.6454**	0.3025	0.9461***	0.3012
Variance-covariance matrix of the residuals	Climate change believer	1					
	Trust in personal responsibility	0.8343		1			
	Trust in governmental responsibility	0.7205		0.6819		1	
Regression diagnostics	Observations	725		725		725	
	RMSE	0.9483		0.9623		0.9584	
	R^2	0.0998		0.0748		0.0813	
	chi^2	80.41		58.58		64.13	

Note: *, ***, *** indicate significance at 10%, 5%, and 1% respectively. Missing coefficients are not significantly different from 0 at 10% of probability or less
Breusch-Pagan test of independence: chi^2 (3) = 1218.16; Pr = 0.0000.

Annex 5: Results of the regression of different factors and policy instruments on environmentally sustainable dietary change

This annex presents the results of the logistic regression analysis that correlated instruments, demographic characteristics, and factors to the decision of the household to improve the sustainability of their food consumption. The use of a logistic regression is preferred because the coefficients of the treatments allow the

researcher to estimate the Odd Ratios (OR), or the increase in probability of a treatment compared to the baseline treatment (Hailpern and Visintainer, 2003). This can be easily done for each coefficient β_i as $OR_{\beta_i} = e^{\beta_i} - 1$.

Results of the choice model are presented in table D1 (for cola, meat, and butter) and D2 (for milk), both with factors only and with factors and demographic characteristics. A detailed description of the results is reported in the main text of this report.

Table D1.   Logit estimation of change as function of shopping motives, trust and beliefs - All products pooled (milk excluded)

		Factors only		Factors+demographics	
		Coef.	S.E.	Coef.	S.E.
	Intercept				
Information	Reading environmental information				
Treatment	Labelling				
	Tax	-0.6766**	0.3033	-0.6645**	0.3196
	Exogenous price change	Reference		Reference	
	Ban	2.0571***	0.2858	2.2670***	0.3126
	Exogenous product removal	2.1282***	0.2874	2.2486***	0.3043
Product	Cola	Reference		Reference	
	meat	-0.9127***	0.2303	-0.9497***	0.2463
	butter	-0.7213***	0.2398	-0.7876***	0.2549
Motives	Social				
	Health				
	Ethical	0.2091**	0.0983	0.1978*	0.1083
	Consumer				
Trust/belief	Climate change				
	Personal responsibility				
	Governmental responsibility				
Personal and household characteristics	Age	-	-		
	ln (income)	-	-		
	No income	-	-		
	Male	-	-		
	HDI	-	-		
	Social class	-	-	-0.0559*	0.0279
	Nr of children	-	-		
Marital status	Single	-	-	Reference	
	Married	-	-		
	Living with partner, cohabiting	-	-		
	Divorced/separated	-	-		
	Widowed	-	-		
	Engaged	-	-		
	Generic relationship	-	-		
Location	Walthamstow	-	-	Reference	
	New Barnet	-	-	-1.2838**	0.5657
	Edgware	-	-	-0.9171**	0.4244

		Factors only		Factors+demographics	
		Coef.	S.E.	Coef.	S.E.
Political stance	Chiswick	-	-	-0.9719**	0.3883
	Merton	-	-		
	Lewisham	-	-	-0.8217**	0.4076
	Radical labourist/conservative	-	-	Reference	
	Conservative	-	-		
	Neutral	-	-		
	Moderate conservative	-	-	0.7226**	0.3511
	Moderate labourist	-	-	0.6402**	0.3028
Education	Non-university	-	-	Reference	
	Graduate	-	-		
	Postgraduate	-	-		
Regression diagnostics	Number of obs	652		652	
	LR chi2	190.79***		224.86***	
	df LR chi2	14		38	
	Log likelihood	-351.62		-334.58	
	Pseudo R2	0.2134		0.2515	

Note: *, ***, *** indicate significance at 10%, 5%, and 1% respectively. - indicates that the variable was not included in the regression. Missing coefficients are not significantly different from 0 at 10% of probability or less

Table D2.   Logit estimation of change as function of shopping motives, trust and beliefs - Milk

		Factors only		Factors+demographics	
		Coef.	S.E.	Coef.	S.E.
	Intercept	-2.9077***	0.3418	-2.0132*	1.1861
Information	Reading environmental information	0.5095**	0.2159	0.4950**	0.2266
Treatment	Labelling				
	Tax				
	Exogenous price change	Reference		Reference	
	Ban	3.1371***	0.3749	3.2143***	0.3858
	Exogenous product removal	2.5947***	0.3692	2.6886***	0.3814
Motives	Social				
	Ethical				
	Consumer	0.1849*	0.1119		
Trust/belief	Climate change				
	Personal responsibility				
	Governmental responsibility				
Personal and household characteristics	Age	-	-		
	ln (income)	-	-	-0.3723**	0.1806
	No income	-	-		
	Male	-	-	0.4300*	0.2302
	HDI	-	-		
	Social class	-	-		
	Nr of children	-	-	-0.2097*	0.1240
Marital status	Single	-	-	Reference	
	Married	-	-		
	Living with partner, cohabiting	-	-		
	Divorced/separated	-	-		

Location	Widowed	-	-	
	Engaged	-	-	
	Generic relationship	-	-	
	Walthamstow	-	-	Reference
	New Barnet	-	-	
	Edgware	-	-	
	Chiswick	-	-	
	Merton	-	-	
	Lewisham	-	-	
Political stance	Radical labourist/conservative	-	-	Reference
	Conservative	-	-	
	Neutral	-	-	
	Moderate conservative	-	-	
	Moderate labourist	-	-	
Education	Non-university	-	-	Reference
	Graduate	-	-	
	Postgraduate	-	-	
Regression diagnostics	Number of obs	725	725	
	LR chi2	225.82***	253.78***	
	df LR chi2	11	35	
	Log likelihood	-295.60	-281.62	
	Pseudo R2	0.2764	0.3106	

Note: *, ***, *** indicate significance at 10%, 5%, and 1% respectively. - indicates that the variable was not included in the regression. Missing coefficients are not significantly different from 0 at 10% of probability or less