Eco-labels, conspicuous conservation and moral licensing: An indirect behavioural rebound effect

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Highlights

We report on two studies into environmentally friendly product purchasing

- Eco-labels thrive in more affluent EU-27 markets
- Eco-friendly friendly product purchasing is linked to higher environmental footprints
- This pattern is particularly pronounced in the case of carbon footprints
- Eco-labelling reflects an indirect behavioural rebound effect
- Eco-labelled product consumption aligns with moral licensing

Abstract

Sustainable consumption is a growing niche with an increasing number of initiatives aimed at lowering domestic environmental consumption footprints. Third-party assured product eco-

labelling has emerged as a key governance mechanism to promote sustainable consumption. However, does the purchasing of eco-labelled products really support a transition towards more sustainable consumption? In this paper, we explore eco-labelling through the lens of the rebound literature. While theorizing of the rebound effect originated in energy economics and has long been centred on eco-efficiency, we extend its rationale to products that are associated with a price premium in return for added environmental quality attributes. Reporting on two inter-related studies into the link between purchasing of environmentally friendly products and different types of environmental resource consumption, we find that eco-labelled products flourish in more affluent economies that are characterised by higher levels of overall resource consumption; and that willingness to consume environmentally friendly products is positively related to higher individual carbon, water and material footprints. Hence, we argue that eco-labelling in its current form is inextricably linked to higher – rather than lower – levels of resource consumption. Consequently, the governance mechanism that underpins eco-labelling is associated with an indirect behavioural consumer rebound effect.

Keywords: Conspicuous Consumption; Eco-labels; Moral Licensing; Rebound Effect; Sustainable Consumption

1 Introduction

Sustainable consumption is advocated as a key approach to reduce environmental resource use, harmful emissions and waste generation associated with the use and disposal of consumer products and services (Middlemiss, 2018; Reisch and Thøgersen, 2015). The UN Sustainable Development Goal 12 on ‘ensuring sustainable consumption and production patterns’ targets, amongst others, material footprints, food loss, hazardous waste, recycling rates and the use of

fossil fuels (UN DESA, 2021). The urgency of these challenges necessitates adequate governance responses, and a plethora of public and private sector initiatives are being implemented with the aim to achieve more sustainable modes of consumption. Eco-labelled products form a central element of this governance mix aimed at sustainable consumption.

Eco-labels inform consumers about a set of environmental quality attributes that are typically linked to a price premium paid in return for these environmental quality attributes (Grolleau et al., 2016). Even though eco-labelled products have long been found to occupy a relatively small niche in the market (ECRA, 2019; O'Rourke and Ringer, 2016), recent growth rates have accelerated, often outstripping those of conventional alternatives (ECRA, 2019). Public support of eco-labelling is commonly associated with the expectation of environmental quality improvements of these schemes. To take one example, the German Sustainable Development Strategy 2016 includes the commitment to grow the market share of eco-labelled products by a factor of four in order to meet the German government's 2030 environmental sustainability targets (UBA, 2019). Individually, eco-labelled product purchases are characterised by incremental behaviour change and very modest potential for environmental quality improvements. However, cumulatively these might reflect significant resource savings at the level of an entire economy; and these easy-to-adopt practices may trigger green spillovers, i.e. prompting consumers to move on to other, more ambitious types of pro-environmental behaviour (Thøgersen and Ölander, 2003; Marian et al., 2014).

Yet, it is not always clear how different food production systems, including those that underpin different eco-labelling schemes, are linked to actual environmental impacts (Poore and Nemecek, 2018). Likewise, consumers may choose to purchase eco-labelled products for a variety of motives other than concern for the environment (Testa et al., 2015), including food

safety and health concerns (Loureiro et al., 2001), moral considerations (Aertsens, 2009), or status (Babutsidze and Chai, 2018). Ultimately, these points raise the question whether the simple scaling-up of current approaches to eco-labelling will be able to actually support the transition to more sustainable consumption patterns (Grolleau et al., 2016). This study reports on two inter-related studies into the link between purchasing of environmentally friendly products and different types of environmental resource consumption. First, an international comparative analysis of EU-27 countries sheds light on consumer-specific and country-specific characteristics that drive eco-labelled product consumption. Second, a UK-centred analysis explores the link between the willingness to pay for environmentally friendly products and different types of environmental resource consumption.

We anchor our study in the rebound literature (Brookes, 1978, 1990; Khazzoom, 1980). Even though the notion of a rebound effect originated in the energy economics literature and has long been centred on the relationship between eco-efficiency and eco-effectiveness (Greening et al., 2000; Sorrell and Dimitropoulos, 2008), we demonstrate that its rationale can be meaningfully applied to the governance mechanism that underpins the use of eco-labels. Eco-labelled products are typically associated with the payment of a price premium in return for an added environmental quality attribute rather than efficiency-induced cost savings, thereby ruling out consumer-level economic rebound effects. Nevertheless, we find the wider rebound literature to be highly applicable to our study, most notably in relation to indirect and behavioural rebounds.

Empirically, we find that eco-labelled products flourish in more affluent economies that are characterised by higher levels of overall resource consumption (Study 1); and that willingness to consume environmentally friendly products is positively related to higher individual carbon,

water and material footprints (Study 2). Hence, we argue that, eco-labelling, as the key governance mechanism underpinning the purchasing of environmentally friendly products, is inextricably linked to higher – rather than lower – levels of resource consumption. Consequently, eco-labelling is associated with an indirect behavioural consumer-level rebound effect. Extending the rebound literature to eco-labels provides us with an analytical lens through which policy instruments can be evaluated, in order to identify systems-wide effects that may, on the aggregate, result in back-firing (Saunders, 2000).

The remainder of our study is structured as follows. In the next section, we review the literature on eco-labels in the context of sustainable consumption as well as the rebound literature, before arguing for the case of eco-labelling as an indirect behavioural consumer rebound. Subsequently, we describe and justify the research design of two empirical studies focusing on environmentally friendly product purchasing in the EU-27 and the UK, respectively. After reporting the main findings generated from our two complementary analyses, we discuss their relevance in light of the extant literature and present a set of implications for policy and practice. We conclude by spelling our potential limitations of our research design as well as identifying promising avenues for future research based on this study.

2 Related Work

2.1 Sustainable Consumption and Eco-labels

A multitude of policy measures are being implemented in response to the growing concerns about unsustainable consumption patterns. At the level of national and local governments, there has been some increase in infrastructure provision, including recycling facilities (Degli Antoni and Marzetti, 2019) and public transport systems (Ingvardson and Nielsen, 2018); incentives such as subsidies for purchasing electric cars (Lévay et al., 2017) or household solar panels

(Palm, 2018); and policies such as a plastic bag tax (Xanthos and Walker, 2017) or landfill tax (Kling et al., 2016). Crucially, however, large parts of the responsibility for this transition towards more sustainable modes of consumption have been shifted to companies as producers and to citizens as consumers (Akenji, 2014; O'Rourke and Lollo, 2015; Schrader and Thøgersen, 2011).

Companies have responded by developing cross sector initiatives in collaboration with pressure groups and government agencies to address specific issues such as deforestation, greenhouse gas emissions, water scarcity or food waste (WRAP, 2020). Many of these initiatives have focused on product supply chain impacts and ensuring consumer buy-in through advertising campaigns and voluntary product standards (Castka and Corbett, 2016). This has mitigated sustainability issue risks for focal firms within the value chain, and extended eco-efficiency practices onto suppliers and consumers (Heikkurinen et al., 2019). On the consumer end, these can be categorised using Schubert's (2017) green nudges taxonomy:

(i) Providing product information or making certain product characteristics more salient (i.e. eco-labels).

(ii) 'Follow the herd', e.g. establishing social norms through peer comparison or stimulating social status competition.

(iii) Setting defaults or choice editing.

In the first category, products with so-called third-party assured 'Type I'-like (ISO, 2018) eco-labels are verified against environmental criteria across the entire product life cycle (e.g. FSC, MSC or Rainforest Alliance) and are widely perceived as more credible than self-declared ('Type II') labels. This paper uses this as the basis for the use of 'eco-labelled products', which have in general a lower environmental burden than like-for-like conventional products. Those backed by legislation (e.g. organic and free-range have legal standing within the EU) are

typically trusted most by consumers (Horne, 2009). However, providing information alone in the form of eco-labels may not suffice to move products from niche to mainstream. Horne (2009) suggests that consumption occurs in the context of practice norms, with shopping being a rushed process characterized by complex emotions and confusion over eco-labelled products. As such, isolated information campaigns centred on eco-labelled products are not sufficient. Instead, further green nudges are required in order to mainstream sustainable purchasing (Grolleau et al., 2016). The second category uses social norm information to trigger the impulse of comparing oneself to others. For example, a food waste reduction intervention may use stickers on food products such as "75% of shoppers avoid wasting their salad by keeping it in the fridge" (Young et al., 2017, p.7.). For the third category, some food retailers and product manufacturers combine eco-labels with the choice editing of product ranges to only offer products with select third-party labels, or to exclude certain ingredients or materials from products (Chintakayala et al., 2018).

For the consumer, sustainable consumption can mean purchasing more sustainable products, sharing (Fraanje and Spaargaren, 2019) and extending the lifespan of products, more efficient use of domestic heating and cooling, lower meat and dairy foods consumption, moving to greener (public) transport, reducing flying, reducing food waste and/or recycling waste (Lacroix, 2018). Consumers may engage in sustainable consumption for a variety of different reasons, including health concerns (Loureiro et al., 2001), moral considerations and concern for the environment (Aertsens et al., 2009). Likewise, they may engage in sustainable consumption in a multitude of different ways, with the spectrum ranging from e.g. buying fresh produce at local cooperatives to purchasing eco-labelled products from mainstream food retailers.

Given that the latter account for the vast majority of market share, the effectiveness of the widely applied eco-labels is of particular importance for the transition towards sustainable consumption. To take the example of the UK, in 2011 the total sales revenues of all UK farmers markets represented the equivalent of 0.4% of the domestic revenues of Tesco as the UK grocery retail market leader (Statista, 2022). Across Europe, the organic market share of mainstream food retailers is estimated to range from 38% in Spain to 80% in Denmark (Agence Bio, 2019). Put simply, the success or failure of the transition to sustainable modes of consumption will then be decided at the counters of mainstream supermarkets.

Yet, there are two main problems associated with shifting sustainable consumption responsibilities towards consumers more generally, and with eco-labelling as a governance mechanism in particular. The first is that even though 94 per cent of European consumers state that protecting the environment is important (EC Environment, 2020), eco-labelled products continue to occupy a relatively small niche in the market (ECRA, 2019; O'Rourke and Ringer, 2016). In other words, purchasing of eco-labelled products constitutes a prime example of the so-called 'attitude–behaviour gap' or 'values–action gap' (Young et al., 2010). Second, it has been shown that eco-labels – as currently practiced – appeal to very specific lifestyles, as shown by extant research into the role of status (Brooks and Wilson, 2015; Griskevicius et al., 2010) and visibility of (sustainable) consumer expenditures (Brick et al., 2017; Heffetz, 2012; Schwartz et al., 2020). As such, retailers and product manufacturers have seized opportunities for product differentiation, gaining market share and combining green credentials with very high mark-ups as well as marketing strategies that are tailored towards highly affluent consumers (Aschemann-Witzel and Niebuhr Aagaard, 2014; Marian et al., 2014; Sexton and Sexton, 2014). This strategy has contributed to eco-labelled products achieving growth rates that outstrip those of non-labelled products even though market share has remained relatively

small in absolute terms (ECRA, 2019). Notwithstanding the fact that environmentally friendly products might be purchased for a variety of different reasons (for a comprehensive overview, see e.g. Aertsens et al., 2009), this lifestyle-specific marketing of eco-labelled products is closely aligned with the use of 'conspicuous conservation' marketing strategies (Griskevicius et al., 2010).

Conspicuous conservation is a modification of the more common term of 'conspicuous consumption' (Sexton and Sexton, 2014). As Griskevicius et al. (2010, p.394) explain: "Because the purchase of green products enables a person to signal that [she/]he is both willing and able to buy a product that benefits others at a cost to [her/]his personal use, activating a motive for status might lead people to engage in conspicuous conservation—public pro-environmental acts." The conspicuous conservation phenomenon also tallies with the notion of 'moral licensing', i.e. a socio-psychological mechanism that describes behavioural patterns in which individuals combine socially desirable activities with undesirable ones (Dütschke et al., 2018; Merritt et al., 2010; Monin and Miller, 2001). Moral licensing could pose a serious problem for the contribution of eco-labelling to sustainable consumption patterns given that purchases of eco-labelled products have been characterized as a typical 'low-cost' pro-environmental behaviour type (Diekmann and Preisendörfer, 2003; Gifford, 2011): for affluent consumers, eco-labelled product purchasing represents a pro-environmental activity that is more convenient and easier to adopt than more impactful, radical activities that require more fundamental lifestyle changes. This low-cost pro-environmental behaviour could then be combined with other types of high-impact behaviours that offset any incremental environmental quality improvements associated with the low-cost behaviour, thereby reflecting moral licensing.

In summary, mainstreaming eco-labelled products and making them accessible to a wider consumer base will be key for the transition towards more sustainable consumption patterns. However, conspicuous conservation and moral licensing dynamics might reduce or even fully offset the positive direct impacts associated with purchases of eco-labelled products. In this study, we explore these processes on the basis of the rebound effect as our analytical lens.

2.2 Sustainable Consumption and the Rebound Effect

A sizeable literature has developed around the idea that environmental quality improvements of a given product or process can – under certain conditions – result in higher environmental impacts (Figge et al., 2014). The origins of the literature on this so-called rebound effect can be traced back to the 19th century (Jevons, 1866). More recently, the phenomenon re-emerged in the energy economics literature (Brookes, 1978, 1990; Khazzoom, 1980) and has since been applied in a range of different contexts such as personal transport, household appliances or domestic heating (Sorrell et al., 2009). This literature has commonly centred on the notion of eco-efficiency. In a wider sense, however, the rebound effect can be defined as "a behavioural or other systemic response to a measure taken to reduce environmental impacts that offsets the effect of the measure" (Hertwich, 2005, p. 86).

The effect size of the rebound effect – and hence its practical relevance – has been subject to controversial debate (Sorrell et al., 2009), with the spectrum of positions ranging from "back-firing" (Saunders, 2000) through to negligible (Lovins, 1988) or even "super-conservation" (Figge and Thorpe, 2019; Saunders, 2008). Back-firing refers to cases in which the response to an eco-efficiency improvement leads to an overall increase in resource use, thus overcompensating for the initial efficiency gains (Saunders, 2008). Conversely, super-conservation indicates that the response to the efficiency-enhancing measure exceeds its initial

effect and leads to an even greater reduction of resource use (Figge and Thorpe, 2019). To some degree, positions regarding the empirical relevance of the rebound effect have depended on the research context and the characteristics of the set of resources that has been investigated, as well as the underlying definition of what actually qualifies as a rebound effect. This also relates to the time-frame and geographical boundaries of the assessment: for example, capturing and modelling the dynamic effects of any efficiency-enhancing measure at the macroeconomic level remains challenging (Gillingham et al., 2016). Notwithstanding these – empirical and conceptual – difficulties, it is commonly acknowledged that the rebound effect is conceptually sound and represents a relevant problem for corporate practitioners and policymakers alike.

For the purposes of this study, we adopt Hertwich's (2005) broader definition in that rebound effects can occur as a consequence of either cost effects or behavioural responses to a measure that is taken to reduce environmental impacts. In addition, we follow the view that the measure that sets the rebound effect in motion can be located either at the level of the consumer or at the level of the producer (Figge and Thorpe, 2019). Synthesizing the extant literature that aligns with this view of the rebound effect, there are then a number of different pathways that the rebound effect can take. These can be categorized on the basis of three dimensions associated with the rebound effect, namely its scope, nature and source.

Direct, indirect and economy-wide rebound (scope). A first dimension concerns the scope of economic activity that is considered. Here, a general distinction can be made between direct, indirect and economy-wide rebound effects (Greening et al., 2000; Sorrell and Dimitropoulos, 2008). A technological eco-efficiency improvement is often associated with the reduction of environmental resource use in production, allowing the producer to offer a product at a lower

price and, as a consequence, stimulating demand; this is referred to as a direct rebound effect (Greening et al., 2000; Khazzoom, 1980). Indirect rebound effects refer to increased demand of other, unrelated goods and services as a result of consumer-level cost savings incurred by the initial environmental quality improvement (Sorrell and Dimitropoulos, 2008). Finally, the same environmental quality improvement may set in motion a series of adjustments throughout the entire economy, based on the initial price reduction and set of cost savings. This is referred to as secondary (Greening et al., 2000), or economy-wide, rebound effect (Sorrell and Dimitropoulos, 2008).

Economic and behavioural rebound (nature). A second dimension concerns the nature of responses to efficiency-enhancing measures. Traditionally, the rebound literature has been rooted in energy economics and has primarily been concerned with the economic consequences of energy saving measures, resulting from substitution effects, price effects and income effects (Greening et al., 2000; Tiefenbeck et al., 2013). More recently, however, it has been highlighted that environmental protection measures unfold not only economic, but also behavioural consequences, thus combining economic and psychological perspectives on the topic (Dütschke et al., 2018; Tiefenbeck et al., 2013). Drawing from social psychology, Dütschke et al. (2018) take the example of moral licensing (Merritt et al., 2010; Monin and Miller, 2001) to explain how an offset in energy savings may bring about behaviour change that, in turn, leads to an increase in energy use as a consequence of the initial energy savings. This negative spillover effect (Nash et al., 2017) is triggered by a sense of moral entitlement when exercising a certain pro-environmental behaviour, leading to the adoption of harmful behaviours in other lifestyle domains.

Consumer and producer rebound (source). Finally, a third dimension distinguishes between two main sources of the rebound effect, i.e. where the environmental improvement measure is located. Figge and Thorpe (2019) argue that extant theorizing has largely concentrated on consumer-producer relationships and demand-side rebound effects stimulated by efficiency improvements, even though similar dynamics are associated with efficiency gains at the level of the supply-side of resources. Using a circular economy setting, they present a "symbiotic rebound effect" that originates from imperfect circularity of resource flows and resultant effects on reuse and recycling rates of these resources. In other words, the rebound effect can either take the form of a demand-side consumer rebound in consumer-producer relationships, driven by substitution, income and price effects (Greening et al., 2000; Tiefenbeck et al., 2013); or it can take the form of a supply-side producer rebound in producer-producer relationships, driven by imperfect circularity of resource flows (Figge and Thorpe, 2019).

The rebound effect dimensions above are not mutually exclusive but can combine in a variety of different ways. For example, extant rebound literature has largely been concerned with direct and indirect economic consumer-level rebound effects (Figge and Thorpe, 2019). All of these different pathways have in common that they explain how eco-efficiency improvements set processes in motion that reduce or even eradicate the initial environmental quality improvement – directly or indirectly, at the level of the producer or at the level of the consumer, and based on economic transactions or based on behaviour change. In addition, all of these pathways are centred on the notion of eco-efficiency, aligning with a cost leadership strategy (Porter, 1980; Shrivastava, 1995). In the following, we will argue that eco-labelling, reflecting a product differentiation strategy (Porter, 1980; Shrivastava, 1995) and involving a price premium associated with a set of environmental quality attributes, can also set in motion an indirect behavioural consumer rebound effect.

2.3 Eco-labels and the Rebound Effect

In contrast to eco-efficiency improvements as the typical focal point of the rebound literature, eco-labels are characterized by product differentiation and a price premium that is paid in return for certain product attributes. The size of this price premium varies substantially depending on the product category, with only marginal differences for products such as free-range eggs or fair-trade coffee, whereas much higher mark-ups are applied to products such as organic chicken or organic milk when compared to conventional product alternatives (Chintakayala et al., 2018). In all of these cases, however, no cost savings occur at the level of the consumer, thus ruling out the possibility of a consumer-level economic rebound.[1] Despite this notable difference, in this study we argue that the wider rebound literature can nevertheless be meaningfully extended to eco-labelled product purchases.

Recent criticism aimed at eco-labelling has focused on the effectiveness of product performance standards (Horne, 2009), the effectiveness of using information to change purchasing habits (Grolleau et al., 2016) and knock-on effects of purchasing eco-labelled products on sustainable consumption (Grolleau et al., 2016; Horne, 2009; Sexton and Sexton, 2014). Numerous authors, including Welford (1997), have pointed out that in a void of missing holistic sustainable consumption policy from government, with just companies and consumers in the driving seat, sustainable consumption becomes focused only on those activities that align with a conspicuous conservation marketing approach. This leaves less conspicuous behaviours such as energy and water consumption in need of policy interventions (Sexton and Sexton, 2014), but these frequently lack political support (Grolleau et al., 2016). Worse still, Sexton

[1] Note that from the perspective of the producer, the higher mark-up for eco-labelled products can be expressed as an eco-efficiency improvement and economic rebounds could in fact occur, depending on how the additional return is used. However, given that this information is proprietary and not publicly available, in this study we restrict our argument to potential consumer-level rebound effects.

and Sexton (2014, p. 316) warn that "conspicuous-conservation goods enable their purchasers to demonstrate their willingness to sacrifice to enhance the environment, the public subsidy of such goods diminishes their reputational value…[and] may, therefore, have the perverse effect of reducing their demand."

Building on the categorization of rebound effect dimensions above, and notwithstanding the fact that economic consumer-level rebound effects are ruled out due to the absence of (consumer-level) cost savings, rebound effects in a wider sense that are associated with eco-labelled product consumption might then be conceivable. In light of conspicuous conservation, moral licensing and the low-cost/high-cost arguments presented above, purchases of eco-labelled products may set in motion an indirect behavioural consumer rebound effect. Low-cost conspicuous conservation activity provides the consumer with a sense of satisfaction, in turn preventing the adoption of more impactful, high-cost pro-environmental behaviours. Along these lines, rather than providing a convenient (low-cost) entry point to sustainable consumption, eco-labels could in fact prevent the adoption of more meaningful sustainable consumption behaviours.

The interaction between high-cost and low-cost behaviours (or highly conspicuous and less conspicuous conservation activities) can take different directions. Engagement in desirable behaviour may prompt undesirable behaviour, in the sense of e.g. rewarding oneself with a chocolate bar after physical exercise. Likewise, feelings of guilt associated with undesirable behaviour may trigger the adoption of desirable behaviour. For the observer, there may not even be an obvious causal relationship between the two activities. What is important is that the individual engages in some sort of conscience accounting (Gneezy et al., 2014), using a type of low-cost behaviour as a justification to sustain a type of undesirable behaviour. Based on

this mechanism, two initially unrelated activities may in fact become two complementary activities reinforcing each other.

To interrogate whether purchasing of eco-labelled products represents a conspicuous consumption activity, setting in motion a moral licensing process and reflecting an indirect behavioural consumer rebound effect, we report on two inter-related studies into the link between consumption of eco-labelled products and different types of environmental resource consumption.

3 Material and Methods

3.1 Study 1

The European Commission conducts Eurobarometer surveys consisting of approximately 1,000 face-to-face interviews per each member state in the European Union (EC Environment, 2020). The surveys collect data to enable the study of attitudes, motivations, behaviours and reactions towards a given topic. This study utilises data from four such Eurobarometer surveys to understand the relationship between eco-labelled product consumption and consumer-specific as well as country-specific characteristics that may help to explain stated consumption behaviour.

Data preparation. Eurobarometer provides survey information collected from individuals about their lifestyles, opinions, and preferences along with their demographic information. We have collated data from four waves (2008, 2011, 2014 and 2017) that have a common question of interest for this study and compiled it for all EU-27 countries. We have also gathered country-level information from other sources (e.g. Euromonitor Passport database, Yale

Environmental Performance Index) and appended it to the Eurobarometer data so that the data format suits the analysis we intend to do.

The data comprises

a. Individual-level consumption of eco-labelled product data.
b. Individual-level characteristics such as gender, age, education, etc.
c. Country-level indicators such as GDP, ecosystem vitality, etc.

Data analysis. Given the nested data structure of our dataset (individual and country-level), the assumption of independent and identically distributed observations will be violated if traditional analysis techniques were used (Flanagin et al., 2004). Furthermore, conventional modelling approaches may underestimate standard errors due to the violation of the above assumption. This may lead to erroneous conclusions regarding statistical significance (Goldstein, 1995). In addition, a methodological unit of analysis problem also arises due to variables at different levels. Multi-level modelling structure handles these issues efficiently and takes care of the clustered nature of the data (Raudenbush and Bryk, 2002).

The dependent variable is individuals' response to purchase of eco-labelled products (as a proxy for the consumption of eco-labelled products). Independent variables are gender, age group, education, etc. at the individual level, and gross domestic product (GDP), number of non-governmental organizations (NGOs), ecosystem vitality, etc. at the country level. We employ multi-level modelling in order to account for clustering effects at the country level. Model estimates were generated in STATA 15.0 (StataCorp, 2017) with a maximum likelihood estimator.

The model takes the form:

Level I (Individual): $Y_{ij} = \beta_{0j} + \beta_{1j} * Gender_{1ij} + \beta_{2j} * Age_{2ij} + \beta_{3j} * Edu_{3ij} + \ldots + \varepsilon ij$ (1)

Level II (Country): $\beta_{0j} = \gamma_{00} + \gamma_{01}\ GDP_j + \gamma_{02}\ Obesity_j + \gamma_{02}\ EcosystemVitality_j + \ldots + u_{0j}$ (2)

Where the variables in the equation(s) are,

- Gender: Male, Female
- Age: How old are you? Recoded into 6 groups; 15-24, 25-34, 35-44, 45-54, 55-64, 65 and above
- Education: How old were you when you stopped full-time education? Recoded into 11 groups; Up to 14yrs, 15yrs, 16yrs, 17yrs, 18yrs, 19yrs, 20yrs, 21yrs, 22yrs and above, Still Studying, No full-time education
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- GDP (EuroMonitor, 2020): per capita GDP in international dollars, measured at Purchasing Power Parity
- Obesity (EuroMonitor, 2020): Percentage of adult population classified as obese (Body Mass Index of 30+)
- EcosystemVitality (Yale University, 2020): Index providing a score for country-level ecosystem protection efforts

3.2 Study 2

This study utilises UK data collected from different sources to understand the relationship between the willingness to purchase environmentally products and levels of environmental resource consumption. The datasets are briefly explained below.

TransUnion data. TransUnion is a consumer credit reporting agency that also produces analytical tools centred on geodemographic classifications. One set of data from TransUnion contains individual-level responses to an attitudinal question about willingness to pay more for environmentally friendly products. A large proportion of individuals in England were asked this question. We have estimated the proportion of people responding 'yes' at each of the 32,844 lower layer super output areas (LSOAs), small geographical units, within England. This variable is used as the dependent variable.

TransUnion's average household expenditure pattern data associated with each geodemographic type is another dataset. Using information on the number of households belonging to each geodemographic type in the super output areas (SOA) of England and the neighbourhood populations it is then possible to generate an average expenditure profile per person at the SOA level. Multiplying the expenditure profile by the set of GHG conversion factors produces an average carbon footprint per SOA. We have estimated the material consumption and water consumption values in a similar fashion. We calculated the values for LSOA level to be able to map to the first data set.

Office of National Statistics data. This dataset consists of sociodemographic characteristics drawn from the Office of National Statistics (ONS, 2015). ONS provides count statistics from the 2011 National Census for England and Wales. We used count data for age group, gender and ethnicity. These counts are aggregated to LSOA geography, so that it corresponds to the dependent variable. Ethnicity has not been widely investigated in relation to sustainable product consumption (Chintakayala et al., 2018).

Index of multiple deprivation (IMD) (GOV.UK, 2015)**.** The index provides a continuous score representing the level of deprivation in a geographical unit. The variable takes into account income, employment, education, health, crime, housing and living environment deprivations.

UK carbon footprint dataset. The University of Leeds was commissioned by Defra to produce the UK's carbon footprint. This is a measure of the greenhouse gas emissions that are emitted anywhere in the world as a result of demand for goods and services by final demand consumers. To calculate the carbon footprint, a UK multiregional input-output database was developed – a set of large trade matrices detailing economic interactions between industries all over the world. Using a technique known as environmentally extended input-output analysis, it is possible to assign the emissions emitted by industries to the point of final consumption. Using information on annual household spends, it is then possible to generate a set of conversion factors for the GHGs per £ spent across 130 different household expenditure items.

Independent variables. We have estimated LSOA level carbon footprint/greenhouse gas emissions taking into consideration individuals' transport, food, clothing, gas, electricity, etc. (overall 130 subcategories). Similarly, we have estimated the material consumption and water consumption levels at each LSOA. While GHG emissions and material consumption are measured in tonnes, water consumption is measured in cubic meters. The index of multiple deprivation is a measure of deprivation level, with high scores representing high levels of deprivation. The other independent variables are the proportions of people in each of the demographic categories age group, gender and ethnicity. LSOA identifier was used as the key variable to merge all datasets.

Data analysis. The dependent variable represents the proportion of people responding 'yes' to willingness to pay more for environmentally friendly products. In other words, it is the probability of an individual's willingness to pay more for environmentally friendly products, in a given LSOA. Since the values of the dependent variable lie between bounds (in this case 0 and 1), following Papke and Wooldridge's (1996) suggestion, we have decided to use a Generalised Linear Model with binomial family and logit link function so that the predictions are also positioned between the bounds. We have developed three separate models to avoid collinearity issues between GHG, Material and Water consumption. Model estimates were generated in STATA 15.0 (StataCorp, 2017).

The model takes the form:

$$Y = \exp(\beta_0 + \beta_1 * IMD + \beta_2 * Resource + \beta_3 * Gender + \beta_4 * Ethnicity + \beta_5 * Age\_under25 + \beta_6 * Age25\text{-}44 + \beta_7 * Age45\text{-}54 + \beta_8 * Age55\text{-}64 + \beta_9 * Age65plus) \quad (3)$$

Where βo is constant, β_1 is a coefficient for IMD, β_2 is a coefficient for GHG/ material/ water consumption, β_3 is a coefficient for Gender, β_4 is a coefficient for Ethnicity, and β_5 to β_9 are coefficients for age groups.

4 Results

Eco-labelled products thrive in more affluent markets. Our first, multi-level, study focuses on an international comparative analysis of EU-27 countries in order to explore factors that drive consumers' purchasing of eco-labelled products (the full set of results is provided in **Table 2**; descriptive statistics are presented in **Appendix A.1**). We utilize Eurobarometer data (EC Environment, 2020), covering 105,917 consumer responses for the years 2008, 2011, 2014

and 2017. Given the nested structure of our dataset (individuals within countries), we apply a multi-level modelling technique (Raudenbush and Bryk, 2002). Our analytical model builds on extant research that has identified a range of individual-level determinants of eco-labelled product consumption (Diamantopoulos et al., 2003; Fisher et al., 2012; Jones III et al., 2017). In addition, previous research has identified considerable country-level differences in sustainable consumption behaviours (Koos, 2011; Lo, 2016), which is also mirrored by the dataset used in this study (**Figure 1**).

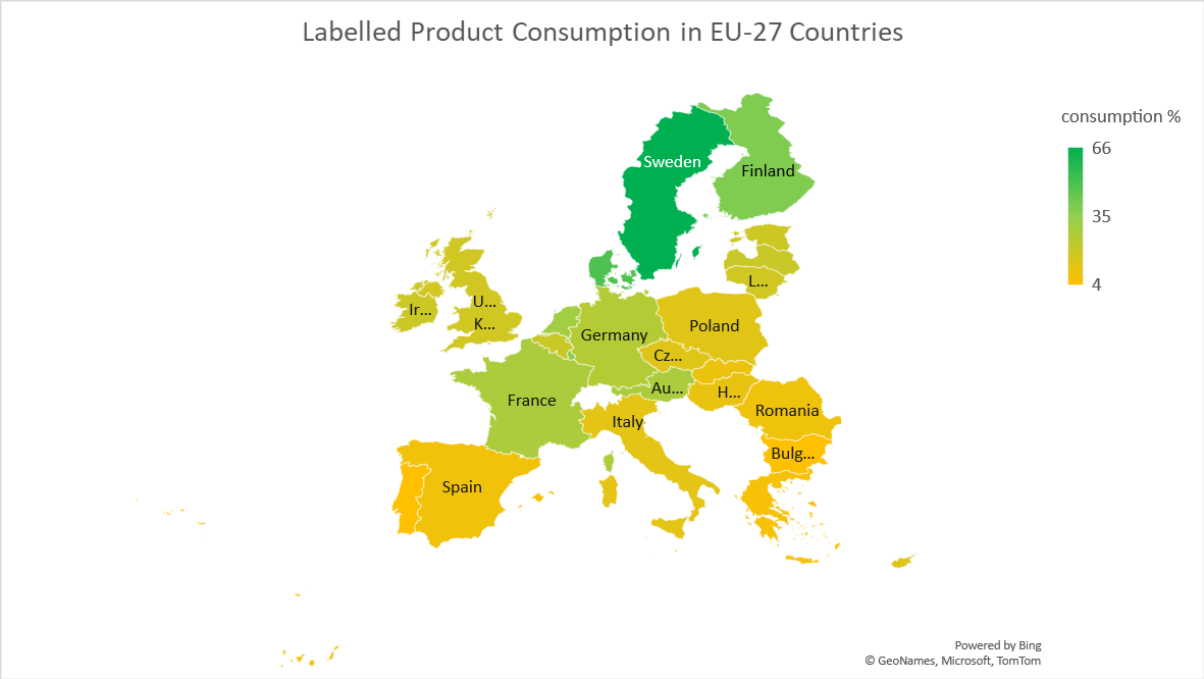


Figure 1 | Purchasing of eco-labelled products in EU-27 countries. Shown is consumers' likelihood of purchasing eco-labelled products across EU-27 countries in the year 2017. Data was collected from the Eurobarometer 2017 survey (EC Environment, 2020). Likelihood of buying eco-labelled products is expressed as a binary variable. Displayed are country-level averages. The colour indicates proportions of consumers indicating 'yes', ranging from 4% (Bulgaria, Portugal) to 66% of the sampled population (Sweden).

Variable	Level	Co-efficient (S.E)
Education	Up to 14years	Base
	15 years	0.012(0.006)**
	16 years	0.010(0.006)*
	17 years	0.023(0.006)***
	18 years	0.033(0.005)***
	19 years	0.049(0.006)***
	20 years	0.056(0.007)***
	21 years	0.066(0.007)***
	22 years and more	0.097(0.005)***
	Still studying	0.068(0.007)***
Gender	Female	0.049(0.002)***
Age group	15-24 years	Base
	25-34 years	0.063(0.006)***
	35-44 years	0.068(0.006)***
	45-54 years	0.058(0.006)***
	55-64 years	0.059(0.006)***
	65 years and older	0.012(0.005)***
Rural-urban	Rural area or village	Base
	Large town/city	0.013(0.003)***
GDP1000		1.24E-6(0.000)**
Year		0.018(0.002)***
Obesity		-0.030(0.003)***
Ecosystem vitality		-0.001(0.000)***
Constant		-34.934(3.353)***
Variance components		
Intercept		0.010(0.003)***
Residual		0.149(0.001)***
ICC		0.061(0.016)***
Observations		103,515
No. of groups		27

Table 2 | Purchasing of eco-labelled products in EU-27 countries. Shown are the results of the multi-level analysis. Estimated treatment effects are shown with standard errors in parentheses. The intra-class correlation coefficient (ICC) is equal to 0.061, meaning that roughly 6.1% of the variance is attributable to the set of country-level characteristics. *** p-value<0.01, **p-value<0.05, *p-value<0.1.

We find an increase of self-reported eco-labelled product purchasing over time, ranging from 18 per cent (2008) through 20 per cent (2011) to 23 per cent (2014), before reverting back to 20 per cent of European consumers (2017). Beyond this modest increase, stable patterns emerge regarding individual-level and country-level characteristics that are found to drive eco-labelled product purchasing. At the level of individual characteristics, female respondents are significantly more likely to be willing to purchase eco-labelled products, as are respondents in the age group 25-44. Furthermore, education levels are significantly positively related to the likelihood of buying eco-labelled products. Respondents living in urban areas are significantly more likely to purchase eco-labelled products than those based in rural areas.

Beyond the individual consumer, we also observe significant country-level differences in perspectives on eco-labelled products. Crucially, GDP per capita emerges as a significant driver of eco-labelled product purchasing (**Figure 2**). Eco-labelled products are thus found to thrive in more affluent markets. At the same time, it is well-documented that higher levels of economic development are generally associated with higher levels of resource consumption (Hoekstra and Wiedmann, 2014). No significant relationship is identified between governance contexts, as proxied by the number of non-governmental organizations (NGOs), and consumers' likelihood of purchasing eco-labelled products. However, the significantly negative link between ecosystem vitality and eco-labelled products shows that damage to the natural environment is associated with a higher market share of eco-labelled products. Interestingly, eco-labelled products also thrive in markets characterized by lower levels of obesity.

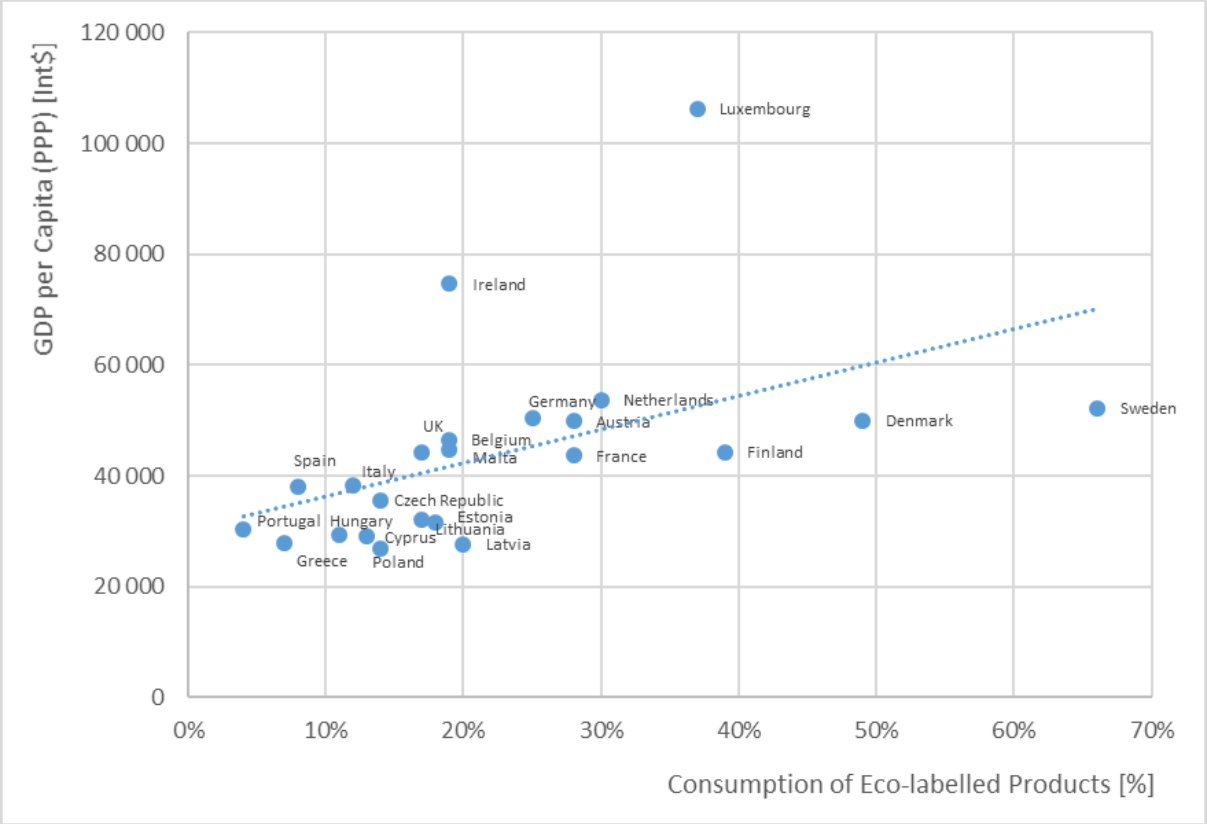


Figure 2 | Scatter plot of GDP per capita and purchasing of eco-labelled products for EU-27 countries (2017). Shown is a scatter plot mapping GDP per capita (PPP International Dollars) and consumers' purchasing of eco-labelled products across EU-27 countries in the year 2017. The dotted line represents the linear trend line for the relationship between the two variables. Data was collected from the Eurobarometer 2017 survey (EC Environment, 2020) and the Euromonitor Passport database (EuroMonitor, 2020).

Customers of sustainable food products have unsustainable environmental consumption footprints. In our second study, we investigate individual-level consumption behaviour, and more specifically the link between willingness to pay for environmentally friendly products and different types of environmental resource consumption in an English setting (the full set of results is provided in **Table 3**; descriptive statistics are presented in **Appendix A.2**). In order to do so, we combine several large-scale datasets (Census, TransUnion, Defra/ University of

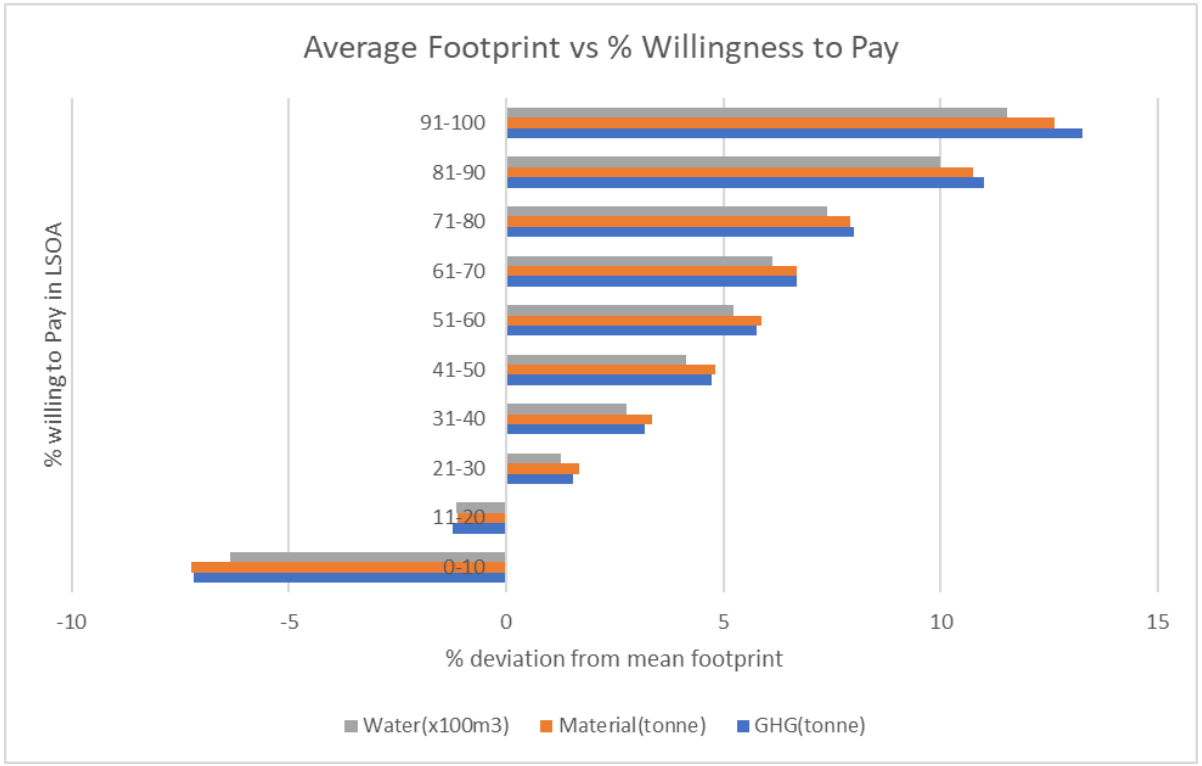
582 Leeds) that among others cover demographic information, attitudinal data, and environmental
583 resource consumption for a representative sample of English consumers. Datasets were merged
584 using "lower layer super output areas" (LSOAs) as the unit of analysis. We developed three
585 separate models in order to account for the fact that greenhouse gas emissions, material
586 resource use and water consumption are not conceptually independent from each other, and
587 thus to avoid potential multicollinearity issues among those parameters.
588

Variable	Level	Model 1	Model 2	Model 3
IMD(2011)		-0.03(0)***	-0.04(0)***	-0.04(0)***
GHG		0.35(0.01)***	-	-
MATERIAL		-	0.19(0)***	-
WATER		-	-	0.002(0)***
Female		-3.84(0.42)***	-3.85(0.42)***	-4.04(0.42)***
White_Ethnicity		-0.58(0.05)***	-0.61(0.05)***	-0.54(0.05)***
Age	Under 25	Base		
	25-44 years	4.98(0.24)***	5.27(0.24)***	5.29(0.24)***
	45-54 years	-5.93(0.5)***	-5.69(0.5)***	-5.50(0.50)***
	55-64 years	-3.75(0.36)***	-3.72(.36)***	-3.61(.36)***
	65 years and older	3.43(0.22)***	3.4(0.22)***	3.47(0.22)***
Constant		-1.9(0.28)***	-1.61(0.28)***	-1.79(0.28)***
Observations		32,844		

589 **Table 3 | Willingness to pay (WTP) for environmentally friendly products and levels of**
590 **environmental resource consumption in England.** We applied a Generalised Linear Model
591 with binomial family and logit link function. Estimated treatment effects are shown, with
592 standard errors in parentheses. *** p-value<0.01; IMD = Index of Multiple Deprivation.
593

594 Unsurprisingly, the analysis of English consumers to a large degree corroborates the main
595 patterns emerging from the European study reported above: a significantly higher willingness
596 to pay for environmentally friendly products can be identified for the age group 25-44, but they
597 are less popular in deprived areas. The higher the LSOA-level proportion of white ethnicity,

598 the lower the level of environmentally friendly products. The latter finding thus tallies with the
599 urban-rural-divide identified across EU-27 countries, given that urban LSOAs tend to be more
600 ethnically diverse. Interestingly, a number of divergences between English and average
601 European consumers can also be identified. First, male English consumers are in fact more
602 likely to purchase environmentally friendly products. Second, this also applies to the group of
603 English consumers aged 65 and over. Neither pattern was observed in a European setting.
604
605 Now turning to environmental resource consumption, a significantly positive relationship with
606 environmentally friendly products was identified across all three model specifications.
607 Consumers' willingness to pay for environmentally friendly products is consistently higher for
608 LSOAs with higher environmental consumption footprints. This pattern is particularly
609 pronounced for levels of greenhouse gas emissions. For material resource consumption and in
610 particular for water consumption, a more modest – but nevertheless significantly positive –
611 relationship with environmentally friendly products is identified (**Figure 3**).



612

Figure 3 | Comparison of LSOAs based on WTP for environmentally friendly products and environmental consumption footprints. Shown is the relationship between the % of people willing to pay for labelled products (Y-axis) and % change in the footprints compared to the average (X-axis). It can be inferred that the footprints are below the national average in areas where there are < 25% of people who are willing to pay for environmentally friendly products whereas in areas where the footprints are well above the average more and more people are willing to pay for environmentally friendly products. This relationship is less pronounced for water footprints, and most pronounced for carbon footprints in LSOAs characterized by very high WTP.

5 Discussion

Eco-labelling schemes, as the dominant governance mechanism underpinning the purchasing of environmentally products, represent a voluntary, consumer-centred governance mechanism aimed at sustainable consumption. Their market-oriented logic and the emphasis of incremental behaviour change – small achievable goals such as switching off lights, turning household heating temperature down and buying greener products – are based on two central assumptions. First, if a critical mass of consumers adopts these relatively small, incremental measures, then collectively this leads to significant resource savings. Second, once people become comfortable with these behaviours, they might be inclined to move on to bigger changes such as eating less meat or using public/greener transport instead of cars. These types of green spillover effects have been evidenced with regard to a variety of household behaviours (Verfuerth and Gregory-Smith, 2018; Manika and Gregory-Smith, 2021), including food purchases (Thøgersen and Ölander, 2003; Marian et al., 2014).

We have found a variety of factors to drive environmentally friendly product purchasing, in turn confirming extant research. For example, eco-labels are found to thrive in markets characterised by higher levels of damage to the environment and lower levels of obesity, thus supporting earlier research regarding the roles of health concerns and environmental awareness (Loureiro et al., 2001; Testa et al., 2015), respectively. Yet, one dominant pattern emerging from our findings is linked to consumer affluence, in turn raising a number of questions regarding the effectiveness of third-party assured product eco-labelling schemes. The international comparative analysis in Study 1 has shown that self-reported eco-labelled product purchases are flourishing in more affluent European markets. The UK-level analysis reported in Study 2 has demonstrated that at the level of individual consumers, the purchasing of environmentally friendly products is inextricably linked to a set of unsustainable behaviours that counteract the potentially positive impacts of eco-labelled product consumption. Consequently, we argue that eco-labelled product purchasing is associated with higher – rather than lower – environmental consumption footprints rather than indicating more sustainable consumption patterns. Conceptually, eco-labelled product consumption then reflects an indirect behavioural consumer-level rebound effect.

An important point to note is that eco-labelled products are typically more expensive compared to conventional alternatives and are often marketed as luxury goods. Current practice shows that the mark-ups applied by retailers are dramatically higher than the relatively modest increase in production costs incurred by eco-labelled products (Chintakayala et al., 2018). As such, eco-labelled products bear similarity with Veblen goods and the model of conspicuous consumption, according to which consumers use brand labels to indicate their social standing and membership within certain groups (Babutsidze and Chai, 2018; Bagwell and Bernheim, 1996; Binder and Blankenberg, 2017). Due to their relative positioning vis-à-vis conventional

alternatives, eco-labelled products are then likely to be locked into a market niche, limiting access to mainstream consumers. Worse still, the indirect behavioural consumer-level rebound effect that is associated with eco-labels effectively rewards unsustainable consumption behaviours.

Our findings align with longstanding research into the so-called 'low-cost hypothesis' (Diekmann and Preisendörfer, 2003; Gifford, 2011): for affluent consumers, eco-labelled product purchasing represents a pro-environmental activity that is more convenient and easier to adopt than more impactful ('high-cost') activities that require more fundamental lifestyle changes. Fundamental lifestyle changes have higher barriers due to structural conditions and social practices (Evans and Abrahamse, 2009) that should be addressed through policy interventions. Affluent consumers may then use eco-labelled product purchasing as a moral licencing mechanism (Merritt et al., 2010) rather than a path to behaviour change, and offset other activities associated with high levels of resource consumption. This could be especially problematic given that previous research has found that consumers who buy eco-labelled products are more likely to become opposed to more stringent government policy once they feel they have made sufficient progress in a given area (Werfel, 2017). This is illustrated by our finding that the relationship between eco-labelled product purchasing and environmental consumption footprints is most pronounced in the case of carbon emissions, which are closely linked to typical high-cost behaviours such as switching to greener modes of transport or foregoing exotic holidays. Ultimately, the use of eco-labelled product purchasing then amounts to a reframing or even hijacking of the notion of sustainable consumption. Recent social movements such as the Extinction Rebellion demonstrations illustrate growing discontent with the perceived hypocrisy of affluent consumers being able to afford eco-labelled products to

686 present themselves as sustainable despite higher levels of resource consumption (Wiedmann et
687 al., 2020).
688
689 Our findings may seem to contradict extant research into green spillover effects (Thøgersen
690 and Ölander, 2003; Marian et al., 2014; Verfuerth and Gregory-Smith, 2018). Due to the cross-
691 sectional nature of the UK-level study, our data cannot speak to this point directly.
692 Conceptually, green spillovers would counteract the indirect behavioural rebound effect we
693 observe. On the one hand, the overall patterns we identify suggest that green spillovers do not
694 fully compensate this rebound effect. On the other hand, it could be argued that without green
695 spillovers, the patterns might even be more pronounced than those identified in our study. The
696 overall patterns generated from our analysis may also suggest that there is a ceiling for green
697 spillover effects. From the perspective of a transition to sustainable consumption patterns, the
698 most effective spillovers would occur from low-cost to high-cost behaviours (e.g. from organic
699 milk to travel behaviour) rather than between two low-cost behaviours (e.g. from organic milk
700 to organic yogurt).
701
702 It is important to note that the adoption of eco-labels should nevertheless be encouraged, as it
703 forms a necessary complement in the governance mix if the transition to sustainable
704 consumption is to be achieved. However, the above findings imply that more substantive
705 changes are needed in the mechanics of eco-labelling schemes as well as regarding their role
706 in the wider governance mix. For corporate practice, this means that eco-labelled products will
707 need to be made more accessible to mainstream consumers in order to increase market
708 penetration. This also entails efforts to reduce the commonly added luxury premium to the
709 price of eco-labelled products and to align marketing activities with those of conventional
710 mainstream products.

From a policymaking perspective, it will be vital to extend eco-labels to high-cost and high-impact behaviours in order to more effectively guide consumption choices on the path to sustainability (Carmichael, 2019). As currently practiced, eco-labels fail to help consumers become more sustainable in their day-to-day lives at the levels needed to achieve reductions in greenhouse gases, food waste, plastic pollution or hazardous waste. For companies, products standards organisations and engaged NGOs, there has to be a change of emphasis for eco-labels from managing environmental and social risks in the supply chain to a focus on helping consumers to reduce resource consumption in their day-to-day environmental challenges. An example where this has been a success is mandatory cross product category energy labelling for household appliances; this approach should be replicated for other product categories such as carbon labelling for food (Camilleri et al., 2019).

Furthermore, our findings illustrate the limited effectiveness of primarily market-based approaches that shift the responsibility for (un)sustainable consumption to the level of the individual consumer. Behaviour change frameworks commonly highlight the role of infrastructure and system changes as the focal point of successful programmes (Klenert et al., 2018; Michie et al., 2011; Young and Middlemiss, 2012). For high-cost and high-impact behaviour change challenges, policymakers need to take a more active approach, implementing infrastructure (e.g. a single and comprehensive national recycling and reuse system) and policy changes (e.g. banning the worst environmentally performing products) in the transition to sustainable consumption. Emphasis will need to shift away from incremental change towards more radical if not revolutionary change focusing on resource use and emissions. Policy interventions should cover a wider spectrum of behaviours, including typical high-cost consumption choices (Diekmann and Preisendörfer, 2003) and be driven by the need for more

equitably distributed resource use and emissions within and between societies (Welch and Southerton, 2019). Key areas include energy and water use, meat and dairy food consumption, waste disposal, transport and of course consumption of products. These should address structural conditions and social practices the present barriers to fundamental change.

6 Conclusion

In this paper, we have explored environmentally friendly product consumption, and with it eco-labelling as its main governance mechanism, through the lens of the rebound literature. While theorizing of the rebound effect has traditionally been centred on the notion of eco-efficiency, we have extended its rationale to products that are associated with a price premium in return for an added environmental quality attribute, namely eco-labelled products. Reporting on two inter-related studies into the link between purchasing of environmentally friendly products and different types of environmental resource consumption, we have found that eco-labelled products flourish in more affluent economies that are characterised by higher levels of overall resource consumption; and that willingness to consume environmentally friendly products is positively related to higher individual carbon, water and material footprints. In other words, eco-labelling in its current form is inextricably linked to higher – rather than lower – levels of resource consumption. We have thus argued that eco-labelling, as the primary tool to promote environmentally friendly product purchasing, is associated with an indirect behavioural consumer rebound effect. Our study contributes theoretically by extending the rebound literature beyond eco-efficiency towards products that are associated with a price premium. Applying the rebound effect to this context provides us with an analytical lens through which pro-environmental policy instruments can be evaluated, in order to identify systems-wide effects that may, on the aggregate, result in back-firing.

Our research design is subject to a number of limitations. Our main dependent variable captures stated preferences rather than revealed preferences such as actual purchasing behaviour. Hence, responses might be impacted by dynamics such as non-response bias or social desirability response bias (Randall and Fernandes, 1991). However, we have no reason to assume differences in social desirability bias across different demographics or geographic locations to be so fundamental so that they, in turn, would change the general patterns derived from either the EU-27 or the UK-based analysis. Furthermore, the analysis does not distinguish between different types of eco-labels. Whilst we acknowledge that there can be significant differences between eco-labels in terms of scope and rigour, it should be noted that market share of "dark green" eco-labels requiring stricter practices is very limited. As such, we argue that our results are likely to be largely representative of the market for eco-labels across the countries included in our analysis.

Furthermore, consumers may choose to buy eco-labelled products for purely ethical reasons such as animal welfare (e.g. RSPCA Assured) or support for disadvantaged producers (e.g. Fairtrade Mark) and may not primarily consider overall environmental resource use. Finally, many food retailers choice edit some product categories to have more eco-labels to reduce the environmental and ethical risks in supply chains (e.g. fisheries sustainable management for fish, free range for eggs, fair trade for coffee, tea and chocolate, animal welfare for meat; and, sustainable forestry practices for wood and paper products). This leads to consumers buying products with eco-labels without searching them out, which may also impact the results reported in our study. Notwithstanding this diversity of individuals' motivations, however, our findings question the overall ability of eco-labels as a governance mechanism to support the transition to sustainable consumption and, ultimately, environmental sustainability. Finally, the cross-sectional nature of the UK-level dataset does not allow us to directly examine potential

green spillover effects. Once updated resource footprint data becomes available, future research will be able to capture green spillovers directly on the basis of changes over time.

Future research building on our present study could also explore the specific dynamics reflected by individual eco-labelling schemes and validate our findings employing more geographically diverse samples. In addition, future research could investigate other types of rebound effects beyond the indirect behavioural consumer-level rebound that has been the focal point of our study. For example, retailers may in fact choose to use the additional return that is generated on the basis of mark-up for eco-labelled products in order to subsidize their conventional product range, thereby representing a direct economic producer-level rebound. This type of research would further illustrate the applicability and explanatory power of extending the rebound literature to products that are associated with the payment of a price premium.

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Appendix A.1: Analysis of EU-27 countries

Variable		**Percentage**
Gender	Male	44.8
Residing in	Rural/village	35.3
	Small/medium town	37.3
	Large town/city	27.4
Education	Up to 14 years	10.5
	15 years	7.2
	16 years	7.1
	17 years	6.3
	18 years	17.9
	19 years	8.8
	20 years	5.3
	21 years	4.1
	22 years and more	23.7
	Still studying	7.6
Age	15-24 years	10.3
	25-34 years	13.9
	35-44 years	16.5
	45-54 years	17.1
	55-64 years	17.7
	65 years and older	24.5
Year	2008	24.7
	2011	24.7
	2014	24.9
	2017	25.8
		Mean (Std.Dev)
GDP		34,000 (13,500)
Obesity Index		23.06 (2.96)
Ecosystem Vitality Index		68.22 (14.50)

Appendix A.2: Analysis of UK lower layer super output areas (LSOAs)

Variable		**Mean (Std.Dev)**
GHG (tonnes)		9.72(1.19)
Material (tonnes)		16.00(2.02)
Water (m3)		1,761(200)
IMD_2011		21.66(15.59)
		Percentage
Age group	Under 25 years	31(6)
	25-44 years	28(8)
	45-54 years	14(3)
	55-64 years	12(4)
	65 years and older	16(7)
White ethnicity		86.22(18.71)
Female		50.8(2.22)

Appendix A | Descriptive statistics. Mean values are shown, with standard deviations in parentheses.