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Got Green Milk?

- A Field Experimental Trial of Consumer Demand for a Climate Label

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ABSTRACT

A majority of consumers claim to prefer climate-labelled food over non-labelled alternatives. However, there is limited empirical evidence that such labels actually influence consumer behaviour when shopping. The purpose of this study is to investigate whether qualitative information about a voluntary climate labelling scheme affects the demand for milk in the short run. In a randomized field experiment conducted in 17 retail stores in Sweden, the effects of a climate label on milk demand was measured. Results suggest that climate labelling increased demand for medium-fat, climate labelled milk by approximately 7%. The response is significantly smaller than suggested by consumer surveys but larger than that observed in earlier studies of actual purchasing behaviour where quantitative information on climate impact was provided.

Keywords: Climate labelling, milk, demand, voluntary policy instruments, randomized controlled trial

I. INTRODUCTION

Food consumption accounts for a large proportion of global greenhouse gas (GHG) emissions. Within Europe, it is estimated that approximately 30% of the GHG emissions originate from food consumption (Tukker *et al.*, 2006). Current trends in food consumption patterns point towards increased demand for food with large environmental impacts, but if consumption patterns of food are altered, then GHG emissions can be lowered substantially (Carlsson-Kanyama and Lindén, 2001; Duchin, 2005; Weber and Matthews, 2008; Carlsson-Kanyama and González, 2009).

Climate labelling is one way whereby food consumptions patterns, at least potentially, can be changed on a voluntary basis (see, e.g., Dietz *et al.*, 2009; Vandenbergh *et al.*, 2011). The first climate label, the so-called Carbon Reduction Label (CRL), appeared in 2007 in the UK. This initiative was launched with an aim to provide companies an opportunity to demonstrate their commitment to decrease the GHG emissions from their products and alter consumer demand towards lower amounts of carbon consumption (Carbon Trust, 2006). Since then, several other countries have followed the UK example. However, there is limited evidence regarding the impact of climate labelling in shifting consumer demand towards more environmentally friendly consumption.

In market surveys, consumers often maintain a high demand for climate labels. Nearly 75% of Swedish consumers claim they would buy climate-labelled food (YouGov, 2010, 2012). In addition, approximately 50% of Swedish consumers claim they are willing to pay a 10-45% price premium on climate labelled milk (YouGov, 2010, 2012). Studies from the UK show similar results (e.g., Gadema and Oglethorpe, 2011). Despite the stated preferences, the market share for climate-labelled milk in Sweden is only approximately 1.5%[1]. Prices, habits, limited trust in labelling schemes, perceived low environmental impact of the own purchases and lack of information and marketing have been suggested as possible reasons for the limited consumer response to climate labelling (Leire and Thidell, 2005; Grankvist and Biel, 2007; Röös and Tjärnemo, 2011).

Further knowledge about the impact of climate labelling on consumer demand is warranted for a number of reasons. First, producers are less likely to voluntarily improve environmental standards in production if it is not likely to increase the demand for their products. Second, environmental organizations and governmental bodies will be uncertain whether support for environmental certification schemes is an effective strategy to reduce the environmental impacts of consumption if knowledge about demand responses to labelling is limited. Third, policy makers are likely to be interested in whether voluntary initiatives can provide significant

[1] According to statistics from the Swedish Dairy Association (Holmström, 2012).

environmental improvements. Successful voluntary schemes could, at least hypothetically, relieve the pressure on governments to introduce more stringent policy instruments such as environmental regulation and taxation, which could meet substantial resistance from different interest groups due to the associated costs.

The purpose of this paper is to investigate whether an in-store information sign on a voluntary climate labelling scheme has the potential to alter consumer demand for climate-labelled milk in the short run. A randomized controlled field trial (RCT) was conducted in 17 grocery stores in the Uppsala region of Sweden. The trial isolated the effect of information on consumption, holding all other conditions constant, thereby measuring the impact of climate labelling on consumer demand for milk. Our results suggest that in-store information has the potential to alter demand for climate-labelled milk. The causal estimates suggest that labelling increased sales of medium-fat climate-certified milk by approximately 7%. Although the response is significantly smaller than suggested by consumer surveys, it is larger than that observed in earlier studies of actual purchasing behaviour where quantitative information on climate impact was provided.

This study is, to our knowledge, the first application of an RCT performed in retail stores to estimate the impact on demand of climate labels on food. One of the few previous studies successful in estimating the empirical impact of a certified food label on consumer demand is Hainmueller *et al*. (2011). This study performed an RCT across 26 stores of a major US grocery chain, to derive the impact of a Fair Trade label on the demand for coffee. Results show that sales of the two most popular bulk coffees rose by 10% when they were labelled as Fair Trade. Additionally, Vanclay *et al.* (2011) used an empirical experiment to determine the effectiveness of a climate label placed on the shelf in a single Australian grocery store. They labelled thirty-seven products in five product lines of high-volume sale items to indicate embodied GHG emissions using a traffic light coloured system. Results show that labelling increased sales by 4% for the least carbon-intensive products, while there was a negative impact on sales of the most carbon-intensive products. Several studies are based on observational market data. For example, Teisl *et al.* (2002) found that consumers responded positively to the Dolphin-safe label and Bjørner *et al.* (2004) obtained an increase in demand from the Nordic Swan label. Kortelainen *et al.* (2013) applied a difference-in-differences approach to test whether there is a price premium for climate-labelled detergents, but their results did not confirm the existence of such a premium.

Compared with earlier studies on climate labelling, which mainly relied upon observational data of product sales, consumer surveys and focus groups (for a review, see, e.g., Cohen and Vandenberg, 2012), we add to the literature by using a randomized controlled experiment. In contrast to Vanclay *et al.* (2011), where results were based on experiments in a single store, the randomized approach in our study facilitates the isolation of the effects of labelling from potential time-varying or product-specific confounding factors, thereby increasing the ability to extrapolate the findings to a broader context. Different from studies that make use of a single time series of scanner data (e.g., Kortelainen *et al.*, 2013; Teisl *et al*., 2002; Bjorner *et al.*, 2004), the cross-sectional variation in this study, in combination with the use of a control group, implies that we avoid confusing the effect of the environmental label with effects due to unobserved market trends (see, e.g., Hainmueller *et al*., 2011). Limitations of this study include measuring only the short-term impact of climate labelling and partial knowledge of consumers' pre-experiment perceptions about the labelled products' climate characteristics.

The remainder of the paper is structured as follows: Section 2 presents the experimental design and Section 3 shows the results of the empirical analysis. Finally, results are summarized and discussed in Section 4.

II. RESEARCH DESIGN

A. *Experimental setting*

To measure the impact of climate labelling on consumer demand for milk, an RCT was conducted in 17 grocery stores. The sample is the full population of Coop stores selling the climate-labelled product. Coop is a Swedish grocery retail group with a market share equal to approximately 20% (KF, 2012). The stores vary significantly in size and turnover as hypermarkets, supermarkets and convenience stores are included. The stores are spread out over a relatively large region including rural, suburban and urban areas throughout Uppsala and Stockholm Counties. Therefore, consumers can be expected to have varying socioeconomic backgrounds, adding to the external validity of the study. The distribution of the sample across stores of various sizes in different types of location and the associated average milk sales is shown in Table 1.

[Table 1 about here]

The consumer good that is the focus of this study is fluid unflavoured climate-labelled milk from the brand Sju Gårdar ("Seven Farms"), which is a local economic association for milk producers. The milk from Sju Gårdar was labelled according to the Swedish standards for Climate Certification of Food (CCF) in 2010 and is the only milk product with this specific label offered in the market area of the study. Prior to the trial, minor marketing efforts were made to market the climate-labelled milk[2]. Thus, the choice of product is motivated by product availability and the insignificant marketing effort associated with it being climate certified and labelled accordingly. Earlier studies also recognized that fluid unflavoured milk is a suitable product choice when studying the demand effects of environmental labelling because it is a relatively standardized commodity with no significant flavour or quality differences among various brands (Kiesel and Villas-Boas, 2007). Milk is also a staple good that consumers purchase in significant volumes. This permits us to assume that the distribution of sales volumes is approximately normal, facilitating identification of a treatment effect.

The CCF is a voluntary labelling scheme requiring that certified food producers strive towards a significant reduction in GHG emissions (CCF, 2012). Reductions are made by focusing on production choices with the largest climate impacts, such as the use of soy protein-based feed, fossil fuels and chemical fertilizer. A requirement for accreditation to a climate label is that the producer already has another quality certification[3]. This requirement is motivated by the climate impact being only one of several sustainability issues to be addressed by farmers, implying that a narrow focus on climate impact alone can lead to sub-optimal decisions (CCF, 2012). The milk from Sju Gårdar fulfils this requirement, as it is also organically certified.

B. Treatment design and randomization of treatments

Treatment design requires consideration of the type of information to present to consumers in the treatment and control groups. First, we note that most existing climate labelling schemes provide consumers with quantitative information about the amount of GHG emitted during the product's life-cycle, such as the CRL (see, e.g., Vandenbergh *et al.*, 2011). However, some schemes only provide consumers with a logo stating that the product is certified, indicating that the producer is committed to reduce GHG emissions from production (Czarnezki, 2011). The Swedish CCF label applies the latter approach. Our treatment design builds on this specific labelling scheme, implying that the results concern the potential effect of voluntary labelling schemes that provide consumers with qualitative information on environmental impact.

In principle, information about climate impacts could be provided in stores for both products that perform better and worse than average, such as performed in Vanclay et al. (2011). Whereas this information could be valuable for the consumer, negative information is less likely to be provided by producers and retailers on a voluntary basis. It also seems unlikely that any government would propose the introduction of a general carbon-labelling scheme including all

[2] The marketing effort was advertisement in local radio and television commercials, with total 20 airings spanning two weeks in 2010, which informed consumers about the climate certification.
[3] From either Svenskt Sigill (Swedish Seal) or KRAV, which are both third-party monitored Swedish labelling organizations.

food products, given the large transaction costs such a system would entail because of the difficulties quantifying the climate impact of products. A compulsory labelling scheme of such type seems unlikely to appear within the foreseeable future. In addition, labelling schemes that rely on providing consumers with quantitative information on carbon emissions can have little or no impact on demand because of the cognitive difficulties for consumers to process this information (Korteleinen *et al*., 2013). Finally, our choice of treatment design is also motivated by ethical considerations, as we were able to provide true and correct information to the consumers that visited the stores included in the experiment.

The intervention consists of two different 18x13 cm signs attached to a shelf in close proximity to Sju Gårdar's medium-fat milk. Sign placement is motivated by the medium-fat milk having the highest sales rates *a priori*. The treatment sign explains that Sju Gårdar's milk is climate certified and the counterfactual placebo sign is identical but without the climate-related information. The use of placebo signs facilitates the isolation of the consumers' response to the environmental information from the marketing effect, which arises when drawing consumers' attention to a product (Carpenter *et al.*, 1994). Given that consumers are used to marketing in the form of signs in the store, the use of signs is unlikely to give rise to biased estimates.

[Table 2 about here]

The factorial structure of the two treatments, T0 as the control and T1 as the treatment (see Table 2), makes it possible to isolate the effect of the climate information (Gerber and Green, 2012). The control treatment, T0, is a pure marketing message, which allows us to control for the marketing effect. Sju Gårdar offers a range of dairy products and by specifically clarifying that the information pertains to milk, the scope of treatment is narrowed to that specific product. The treatment of interest, T1, builds on the design of T0, but adds the information that the milk from Sju Gårdar is climate certified. Because trust and third-party monitoring of a climate labelling scheme are important for a climate label to be effective, the provision of a URL address that supplies information about the CCF standards validates the claim of certification and reduces the risk of mistrust therein. The signs used in the experiment can be found in the Appendix.

Treatments were introduced on a weekly basis following a randomly assigned scheme running over a four-week period[4]. The use of a random assignment method allows for

[4] A pilot study was conducted prior of the launch of the experiment to test the experimental design. Based on the outcome of the pilot study, we choose to vary treatment on a weekly basis to reduce the risk of non-compliance, which seemed to increase the effort required by store employees. The actual intervention took place 2013-04-06 – 2013-05-03.

exploitation of within-store variations and controlling for external demand variations over time. Treatments were normally distributed to consider the difference among stores with regard to size and demographics. The random assignment procedure resulted in comparable treatment and control groups with similar background characteristics and covariate balance in expectations[5]. A table showing the distribution of treatment over stores is found in the Appendix.

C. The data

Scanner data are used to estimate the effect on demand. Altogether, 23 different fluid unflavoured milk products (low-, medium- or standard-fat content) with associated purchases and prices are included in the final panel dataset. To ensure comparison of relatively homogeneous products, extra low- and extra high-fat milk, non-lactose milk, non-dairy alternatives (e.g., soy and rice milk) and flavoured milk are excluded from the final dataset. The grocery stores included in the sample offer a variety of unflavoured fluid milk products to consumers, but not every store offers all of the 23 milk products. In particular, one of the stores does not offer organic milk other than that produced by Sju Gårdar. For tractability, we aggregate the daily sales to weekly data. In addition to balancing the data, the use of weekly data reduces autocorrelation of price observations considerably.

The quality and reliability of the data are high because the risk of measurement errors is minimal. Potentially other factors could affect the quality of the dataset, such as non-compliance to the treatment protocol. To minimize the risk of non-compliance, all store managers and responsible employees were personally visited and informed about the trial. A detailed scheme with instructions on when signs were to be changed was provided. At every instance when signs were to be changed, stores were directly contacted to confirm that the sign had been correctly erected. In addition, unannounced visits were made to all stores to verify compliance with assigned treatments. Overall, the compliance was high; only one instance of deviation from the treatment protocol was detected for the 68 observations, leading to the conclusion that the internal validity with respect to compliance is high.

Only products that have actually been purchased are registered in the cash register and consequently, missing values may represent either that the product is out of stock or that no purchases were made although the good was available in the store. The conditions for using

[5] The claim of a successful randomization procedure is tested through a regression of a binary treatment variable—indicating the assignment to either the treatment or control group—on the full set of covariates. The result from this test supports that the randomization procedure was successful in creating comparable treatment and control groups and suggests that the randomization successfully orthogonalized the assignment with respect to confounding factors (see results in the Appendix).

intention-to-treat (ITT) estimation (Gerber and Green, 2012) are satisfied as the assignment to treatment is highly correlated with actual treatment received and not correlated with the error term. Observations are analysed as if treatments were received according to the initial assignment of treatments following the ITT-logic (Newell, 1992) and therefore, all missing values in the dataset are replaced with zeroes. Consequently, all of the following reported estimates are based on the ITT method.

III. RESULTS

The trial is designed to investigate whether an in-store information sign on a voluntary climate labelling scheme has the potential to alter consumer demand for climate-labelled milk in the short run. The hypothesis tested is whether consumption of milk changes when information about a climate label is present, compared with when it is not. Average sales in the presence of climate impact information will be compared with average sales without that information—hereafter referred to as the average treatment effect (ATE). Our quantities of interest are the effects of the information on sales of climate-labelled milk and sales of the main alternative milk products—organically produced milk without climate certification and conventional milk.

If demand for the climate-certified milk is more elastic than the demand for the alternatives or if the treatment design does not fully account for marketing spill-over effects, then the total sales of milk can potentially increase due to the climate information (cf., e.g., Krishna and Rajan, 2009). To identify if such an increase has resulted, we initiate the analysis by estimating the effect of climate information on the aggregate sales of *all* milk products in the dataset. The analysis of total sales is followed by estimation of the ATE on *(i)* aggregate milk demand for the three different product types and *(ii)* demand for medium-fat milk for the three different product types. The latter is motivated by the medium-fat milk being the product with the largest sales volume and by the sign being placed in close proximity to that particular type of milk, implying that consumers may perceive that the information primarily pertains to the medium-fat milk.

A. Effects on aggregate sales

The estimation of the ATE on aggregate milk sales will show whether it is more relevant to analyse changes in sales volumes or market shares for different milk products in the subsequent evaluation. Market share is a suitable measure if aggregate demand is unaffected by the trial but less informative if aggregate demand is influenced by the treatment. This estimation is conducted by using first the total sales of milk, then the ratio of aggregate sales of all milk to total turnover in the store as the dependent variable. This is convenient, as most of the explanatory power stems from store size, for which total turnover can be viewed as a complement. We estimate the following regression equations to estimate the ATE:

$$\log S_{ALL,it} = \alpha + \beta_1 T_{it} + \beta_2 \log Turnover_{it} + \beta_3 \log \bar{P}_{ALL,it} + \gamma_i + \delta_t + u_{it} \quad (1)$$

$$\log S_{ALL,it} - \log Turnover_{it} = \alpha + \beta_1 T_{it} + \beta_2 \log \bar{P}_{ALL,it} + \gamma_i + \delta_t + u_{it} \quad (2)$$

where $S_{ALL,it}$ represents the aggregate sales of all of the 23 milk products over the experimental period of $t = 1, 2, 3, 4$ weeks in $i = 1, 2, \dots, 17$ grocery stores. Thus, there are a total of $i \times t = 17 \times 4 = 68$ observations. The term T_{it} is a binary variable for treatment. The coefficient β_1 represents the estimated magnitude of the ATE on the total sales of all milk products. To increase the precision in the estimated ATE two covariates, store turnover and the mean milk price in the store are controlled for as well. The variable γ_i captures store-specific effects, δ_t controls for week-specific effects and increases precision in the estimate, and finally, u_{it} represents the idiosyncratic error term that may change across *t* and *i*.

By including γ_i and δ_t, we control for the unobserved heterogeneity within the stores and over weeks (Angrist and Pischke, 2008). The unobserved heterogeneity in store-specific effects could be due to demographics differences among the store's customers or to local competition with nearby stores, whilst the week-specific effects could be explained by fluctuations in demand over time that affect all shops equally. For example, demand could be higher close to paydays or certain holidays. Maximum precision is achieved by estimating the store-specific random effects with GLS and including unobserved heterogeneity over time[6]. We estimate all regressions with robust standard errors and use a logarithmic transformation for the dependent variable because of the considerable variation in store size and for the ease of interpretation, given that coefficients then can be interpreted as percentage changes. The results from the estimation of equations (1) and (2) are presented in Table 3 and referred to in the table as models 1 and 2, respectively. The estimates suggest that climate information has no significant effect on the total volume of milk sales. However, the estimated coefficient has a positive sign. As we cannot exclude a positive impact of climate information on the whole product group, we also cannot exclude the possibility that milk purchases increase in total at the expense of other product groups, even though we find

[6] A Hausman test showed that random effects are more suitable (Prob>chi2 = 0.518). Performing a Breusch-Pagan Lagrange multiplier test resulted in the same conclusion (Prob>chi2 = 0.000). Using random effects will in this case yield a higher precision and since the random effects are orthogonal to the regressor (treatment dummy), using random effects for the analysis would be justified (Gerber and Green, 2012).

no statistical evidence of such substitution. In the following, we will therefore estimate changes in both sales and market shares of the different product types.

[Table 3 about here]

B. *The effect on climate-certified milk and product substitutes*

The analysis is continued by estimating the ATE on the sales of climate-labelled milk and the sales of the main substitutes. The three main product categories investigated are: *(i)* climate-certified milk; *(ii)* certified labelled organic milk; and *(iii)* conventional milk. All of the 23 fluid unflavoured milk products in the dataset are allocated to one of these three product categories. The aggregated sales of each milk product category are used as the outcome variable in the following regression framework. Analogous to equation (1), we estimate the following regression:

$$\log S_{jit} = \alpha + \beta_1 T_{jit} + \beta_2 \log Turnover + \beta_3 \log \bar{P}_{jit} + \beta_4 \log \bar{P}_{kit} + \gamma_i + \delta_t + u_{it} \qquad (3)$$

where the outcome variable of interest, S_{jit}, is the volume of milk sales in product category $j = 1, 2, 3$. In this setting, β_1 represents the estimated magnitude of the ATE on each of the milk product categories when treatment T1 is presented to consumers. By the inclusion of the two price regressors, β_3 and β_4, we control for the impact of prices on milk demand. The two coefficients represent the own-price elasticity of demand for milk product category j and the cross-price elasticity of demand for milk product k, respectively[7]. Given the small variation in prices in the dataset, we also estimate an alternative model where we instead use the price ratio between the product categories as an explanatory variable, according to equation (4):

$$\log S_{jit} = \alpha + \beta_1 T_{jit} + \beta_2 \log Turnover + \beta_3 \log \frac{\bar{P}_{jit}}{\bar{P}_{kit}} + \gamma_i + \delta_t + u_{it} \qquad (4)$$

[7] The construction of price variables has been chosen considering that all of the 17 stores do not carry all the 23 milk products and that milk is provided in both 1- and 1.5-liter packages. An average price per liter and product category in each per store has been used in the estimations.

Furthermore, the impact of climate information on milk demand is also estimated using the market share of milk product category j as the response variable; see equations (5) and (6).

$$\log S_{jit} - \log S_{ALL\,it} = \alpha + \beta_1 T_{jit} + \beta_2 \log Turnover + \beta_3 \log \bar{P}_{jit} + \log \bar{P}_{kit} + \gamma_i + \delta_t + u_{it} \quad (5)$$

$$\log S_{jit} - \log S_{ALL\,it} = \alpha + \beta_1 T_{jit} + \beta_2 \log Turnover + \beta_3 \log \frac{\bar{P}_{jit}}{\bar{P}_{kit}} + \gamma_i + \delta_t + u_{it} \quad (6)$$

The results of regressions (3) – (6) for climate-certified milk and milk product substitutes are shown in Table 3 and Table 4, respectively. Results indicate that the presence of information on the climate certification has a positive effect on total sales of the labelled product. In Table 3 (model 3-6), the estimates suggest that the presence of climate information increased aggregate sales of the climate-certified milk by 2.7-2.9% compared with sales in the control group. However, when testing the hypothesis that the average effect of the climate label information is zero no significant result can be found. As a result, a larger sample would be needed to establish a clear relationship if there is one. As expected, turnover is significant in equations (3) and (5) and the coefficient has the expected sign.

[Table 4 about here]

[Table 5 about here]

Results in Table 4 (model 1-4) suggest that treatment leads to a decline in the aggregate sales of organically produced milk compared with the control, although the outcome is not significant at standard levels. Furthermore, the Table 4 (model 5-8) results suggest that the impact of climate information on the aggregate sales of conventionally produced milk is positive, albeit not significant.

The treatment sign was displayed in close proximity to the climate-certified medium-fat milk. Moreover, the green colouring of the sign coincides with the colour used on the package for medium-fat milk of most brands. It is therefore possible that consumers associate the information presented in a green colour on the signs with the medium-fat milk. Furthermore, some of the low- and standard-fat milk products were not offered to consumers in all stores, implying that it can be less suitable to use aggregate milk sales in each product category as the dependent variable, compared with using the sales of the medium-fat milk. This motivates an investigation of the specific impact on the medium-fat milk products. Therefore, we estimate equation (3)-(6) in a similar manner as above, but now only considering sales of medium-fat milk in the three different product categories. The results from these estimations, which can be found in Table 5, give a coefficient of the same sign as in Tables 3 and 4, but the impact of the presence of climate information on the climate-certified milk is both larger and statistically significant. These estimates show that climate information increased sales of the medium-fat climate-certified milk by approximately 7% on average compared with the control group. The results from this sub-sample analysis also indicate a positive impact of climate information on conventionally produced milk, combined with a reduction of the sales of organically produced milk, estimated effects are robust but not statistically significant. All coefficients in this sub-sample estimation give the expected sign.

Taken together, the results suggest that consumers react to the climate information provided through the labelling by increasing the demand for climate-certified milk. In particular, consumers increase their purchases of the climate-certified milk which is placed the closest to and similarly coloured as the treatment sign. Results also indicate that increased sales of climate-certified milk are also potentially associated with a reduction in the purchases of organically produced milk.

IV. CONCLUDING REMARKS

The purpose of this study is to investigate whether information about a voluntary climate labelling scheme affects the demand for milk in the short run. The study contributes to the literature on environmental labelling through applied empirical analysis of the impact of climate information on milk demand. By conducting a randomized controlled field trial, we measure the average response of milk demand to the introduction of a certified climate label. The trial was conducted across a variety of geographical locations, hence capturing a wide consumer group, which strengthens the general validity of the results. The climate information was manipulated experimentally through an in-store information sign placed in close proximity to the medium-fat climate friendlier milk. Findings suggest that information signs on the shelf have the potential of increasing the demand for climate-certified milk by approximately 7%.

This result confirms the observation in earlier studies that the actual consumer response to climate labelling is far below consumers' stated willingness to buy climate-labelled products, thereby highlighting the weaknesses of market survey methodologies where voicing support for environmentally friendly products is costless (Vermeir and Verbeke, 2006; Murphy *et al.*, 2005; List and Gallet, 2001). The milk preferences consumers reveal in a real market setting, when they are actually spending their money, thus seem to differ substantially from the preferences declared in surveys.

The estimated magnitude of the increase in sales of the climate-labelled milk can be compared with results from previous in-store experimental studies on demand effects of environmental labelling. For example, Hainmueller *et al*. (2011) find that the sales of coffee rose by 10% when consumers received information that it is Fair Trade certified. Additionally, Vanclay *et al*. (2011) find that a "green light" carbon label increased sales by 4%. It can be noted that our estimated impact on climate-labelled medium-fat milk is larger than that in Vanclay *et al*. (2011), although the labelling in both cases indicates impacts on the same public good, namely impact on the climate. Yet, the impact on aggregate demand for the climate-labelled milk is smaller in our study compared with the "green light" products in Vanclay *et al*. (2011) and not statistically significant. This suggests that further investigation of the respective role of label design and label information for consumer response is necessary to predict the effect of climate labelling schemes. Notably, the Fair Trade label analysed in Hainmueller *et al*. (2011) is more likely to be associated with differences in consumption quality (e.g., taste differences of coffee brands), which might explain the higher impact in that study compared with ours.

Our trial also indicates that the increased sales of climate-certified milk are associated with a decrease in the sales of organic milk, hence suggesting that changes in demand could result from "green" consumers shifting between different environmental labels. Such substitution would imply that it is not evident that the net environmental impact will decrease as a consequence of the introduction of voluntary climate labelling, given that milk production affects not only GHG emissions but also has other environmental consequences such as biodiversity and nutrient losses. Hence, substitution effects of this type are potentially important for policy makers, producers and retailers.

Evidently, if climate-certified products are simultaneously associated with higher prices compared with other substitutes, this likely will reduce the impact of climate labels on demand for the labelled product, as suggested by Vanclay *et al*. (2011). It might be that, to change the behaviour of most consumers, the price premium on climate-certified products must be smaller than what is privately optimal to the producer or retailer.

Failing trust in labelling schemes and perceived low environmental impact of purchases can also affect consumers' willingness to purchase climate-labelled food (Cason and Gangadharan, 2002; Upham, Dendler and Bleda, 2011; Röös and Tjärnemo, 2011). If consumers do not trust labelling schemes, behavioural changes cannot be expected to occur. The risk for distrust in labelling or falsely perceived low environmental impact of food choices could potentially be higher with a qualitative labelling scheme. Alternatively, quantitative information about climate impact can have other disadvantages including the cognitive difficulties of consumers to process advanced and abundant information on such a climate label. Although more detailed information on the label can provide consumers with more adequate information on the environmental impact, there are difficulties for consumers to notice, understand and compare quantitative carbon emissions information. This can imply that the effect of additional information can be counterproductive, such as indicated in the study by Kortelainen *et al.* (2013).

It is possible that the issues of trust and perceived environmental impact also affect the outcome of our experiment given the hitherto small use of and hence, the limited knowledge about the Swedish climate label. Consequently, the results from our study may underestimate households' actual valuation of the climate impact from milk production. Related to this, we capture only the short-term impact of a climate label on milk demand. The long-term impact may well differ from this, as the level of trust and perceived environmental impact might increase. Furthermore, studying only short-term impacts will not indicate how increased public exposure to climate-related information in stores will help to foster the conditions in which more substantive demand shifts can take place.

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APPENDIX A

[Table A1 about here]

[Table A2 about here]

[Table A3 about here]

[Figure A1 about here]

TABLES

Table 1. Descriptive statistics of store sample

Region	Share of sample (%)	Sales of all milk (litres)	Sales of climate milk (litres)	Sales of organic milk (litres)	Sales of conv. milk (litres)
Rural	35.3	1,795	161	52	1,583
		(770.6)	(67.7)	(39.2)	(774.3)
Suburban	29.4	6,026	794	277	4,955
		(4374.5)	(649.3)	(205.6)	(3825.3)
Urban	35.3	2,475	341	146	1,988
		(1050.1)	(154.3)	(109.5)	(1819.8)
Store size					
Convenience store	23.5	1,196	308	84	804
		(194.6)	(108.3)	(56.4)	(87.0)
Supermarket	53.0	1,906	256	90	1,560
		(704.9)	(174.3)	(66.6)	(666.7)
Hypermarket	23.5	8,453	861	357	7,235
		(2,597,5)	(716.7)	(196.3)	(2,046.2)

Note: The unit of the sales of milk containers (either 1 or 1.5 litre) is presented as averages per week during the 4-week experimental period. Standard deviations in parentheses.

Table 2. Factorial structure of treatment signs

	T0	**T1**
Logo-type	*Seven Farms*	*Seven Farms*
Product	*Milk*	*Climate Certified Milk*
Implication of CCF	-	*“We have committed to decrease our climate impact”*
Validity of CCF	-	*URL-address to information about the CCF standards*

Table 3. Effect of climate information on sales of all milk and climate-labelled milk

Model No. Variable (log)	(1) All milk	(2) All milk/ Turnover	(3) Climate Milk	(4) Climate Milk	(5) Climate/ All milk	(6) Climate/ All milk
Climate information	0.003	0.004	0.029	0.029	0.028	0.027
	(0.007)	(0.007)	(0.028)	(0.027)	(0.029)	(0.029)
Turnover	0.925***		0.830***	0.780***	0.073	-0.080
	(0.049)		(0.165)	(0.142)	(0.173)	(0.163)
$P_{1,2,3}$	-0.825	0.469				
	(2.100)	(1.956)				
P_1			6.473		31.144	
			(18.646)		(21.798)	
$P_{2,3}$			0.520		0.279	
			(2.991)		(3.431)	
$P_1/P_{2,3}$				-0.578		-0.664
				(2.912)		(3.239)
Constant	-0.371	-4.409	-20.926	-2.642*	-82.747	-0.885
	(5.033)	(4.699)	(47.660)	(1.533)	(54.822)	(1.893)
Observations	68	68	68	68	68	68
Rho	0.974	0.968	0.984	0.984	0.989	0.988

Note: The dependent variable is represented by the heading of each column. All variables are logged. Robust standard errors in parentheses. Store random effects and week fixed effects are included in all regressions. P_1 represents the average price for climate-labelled milk; P_2 represents the average price for certified labelled organic milk; P_3 represents the average price for conventional milk, and P_{12} represents the average price for milk products 1 and 2 together, as an example.* Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level.

Table 4. Effect on sales of certified labelled organic milk and conventional milk

Model No. Variables (log)	(1) Organic milk	(2) Organic/ All milk	(3) Organic milk	(4) Organic/All milk	(5) Conv. milk	(6) Conv./ All milk	(7) Conv. milk	(8) Conv./ All milk
Climate information	-0.038 (0.063)	-0.042 (0.059)	-0.047 (0.060)	-0.054 (0.056)	0.005 (0.010)	0.003 (0.005)	0.006 (0.010)	0.003 (0.005)
Turnover	1.224*** (0.125)	0.355*** (0.128)	0.922*** (0.235)	-0.070 (0.292)	0.92*** (0.086)	0.033 (0.049)	0.96*** (0.084)	0.054 (0.044)
P_2	0.210 (3.354)	-1.189 (3.206)						
$P_{1,3}$	27.041** (12.404)	40.605*** (12.118)						
$P_2/P_{1,3}$			1.764 (2.321)	1.564 (2.661)				
P_3					0.307 (0.553)	0.328 (0.251)		
$P_{1,2}$					-2.208** (0.882)	-1.3** (0.604)		
$P_3/P_{1,2}$							0.401 (0.547)	0.376 (0.252)
Constant	-32.4*** (11.010)	-38.93*** (10.599)	-5.595** (2.608)	-2.385 (3.216)	2.216 (2.210)	1.926 (1.830)	-2.9*** (1.038)	-0.667 (0.487)
Observations	63	63	63	63	68	68	68	68
Rho	0.835	0.833	0.864	0.885	0.984	0.982	0.983	0.982

Note: The dependent variable is represented by the heading of each column. All variables are logged. Robust standard errors in parentheses. Store random effects and week fixed effects are included in all regressions. P_1 represents the average price for climate-labelled milk; P_2 represents the average price for certified labelled organic milk; P_3 represents the average price for conventional milk, and P_{12} represents the average price for milk products 1 and 2 together, as an example. * Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level.

Table 5. Effect of climate information on sales of medium-fat milk

Model No.	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Climate medium	Climate medium	Conv. medium	Conv. medium	Organic medium	Organic Medium
Climate information	0.069* (0.036)	0.071** (0.036)	-0.001 (0.013)	-0.001 (0.013)	-0.048 (0.084)	-0.078 (0.083)
Turnover	0.804*** (0.287)	0.919*** (0.212)	0.812*** (0.079)	0.854*** (0.073)	1.043*** (0.162)	0.633*** (0.232)
P_{1med}	-25.565 (26.680)					
$P_{2,3med}$	7.096*** (2.705)					
$P_{1med}/ P_{2,3med.}$		-5.825** (2.467)				
P_{3med}			-3.57*** (0.780)			
$P_{1,2\ med}$			2.037 (2.001)			
$P_{3med}/ P_{1,2\ med.}$				-3.81*** (0.839)		
$P_{2\ med}$					-7.597*** (1.999)	
$P_{1,3med}$					21.058*** (3.016)	
$P_{2med}/ P_{1,3med.}$						-6.279* (3.363)
Constant	45.745 (66.970)	-3.010 (1.858)	0.575 (4.358)	-3.72*** (0.618)	-39.34*** (8.642)	-3.135 (2.588)
Observations	68	68	68	68	63	63
Rho	0.961	0.960	0.956	0.953	0.591	0.663

Note: The dependent variable is represented by the heading of each column. All variables are logged. Robust standard errors in parentheses. Store random effects and week fixed effects are included in all regressions. P_1 represents the average price for climate-labelled milk; P_2 represents the average price for certified labelled organic milk; P_3 represents the average price for conventional milk, and P_{12} represents the average price for milk products 1 and 2 together, as an example. * Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level.

Table A1. Distribution of treatment (T1)

Intensity of treatment (T1) per week	No. of observations per treatment intensity	No. of stores per treatment intensity	% of sample
0	4	1	5.88
1	16	4	23.53
2	28	7	41.18
3	16	4	23.53
4	4	1	5.88
Total:	68	17	100

Table A2. Test of randomization

Variables	Climate information	P-value	R-square
Turnover	0.000 0.000	0.560	0.005
No. of receipts	0.009 (0.00)	0.228	0.021
Convenience store	-0.088 (0.145)	0.547	0.005
Supermarket	0.590 (0.123	0.633	0.004
Hypermarket	0.000 (0.145)	1.000	0.000
Rural	0.193 (0.127)	0.132	0.034
Suburban	0.070 (0.135)	0.601	0.004
Urban	-0.258** (0.125)	0.043	0.060

Note: Probit coefficients shown with standard errors in parentheses. The dependent variable is a binary treatment variable coded 0 for control (T0) and 1 for treatment (T1).

Table A3. Summary statistics for milk data

Variable	Mean	Std. Dev.	Min	Max	N
Sales all climate-certified milk	410.5	444.1	58	2,173	68
Sales all conventional milk	2,717.7	2,763.9	660	9,736.5	68
Sales all ECO-milk	151.3	157.9	0	723	64
Sales medium climate-certified	257.4	275.1	29	1,338	68
Sales medium conv. milk	1,601.2	1,553.3	395	5,607	68
Sales medium ECO-milk	86.2	88.9	0	438	64
Price all climate-certified milk	12.82	0.10	12.62	12.88	68
Price all conventional milk	7.53	1.09	6.02	9.57	68
Price all ECO-milk	10.34	0.72	8.90	11.45	64
Price medium climate-certified	12.78	0.13	12.55	12.85	68
Price medium conv. milk	8.20	0.69	6.75	9.45	68
Price medium ECO-milk	10.13	0.68	8.73	11.15	64

Figure A1. Control, T0 (to the left), and treatment, T1 (to the right)

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