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- Evidence from a randomized field experiment in a Swedish setting

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Abstract

There is a generally accepted need to decrease the environmental impact and global greenhouse gas (GHG) emissions caused by the food industry. Studies have shown that by altering the consumption patterns of food products, the emissions of GHG can be substantially lowered (Carlsson-Kanyama and González, 2009). Climate labeling for food products is an example of a policy instrument recently initiated in many countries in order to inform consumers, influence choices about food consumption and thereby reduce GHG emissions of the industry. Even though the interest in climate labeling schemes is growing all around the world little evidence exist showing that climate labeling schemes are actually an effective policy instrument in mitigating GHG emission in the food industry. There is a recognized need for better understanding of consumer response and demand for climate labels. This is the first study to report results from a randomized controlled field experiment in which the researcher manipulates product labels to estimate demand effects of a climate label across multiple retail stores. The experiment was conducted in a Swedish setting by studying the sales of climate certified milk products, certified according to the standards of a Climate Certification of Food (CCF). This experiment has found that the climate certification has a positive effect on sales of the labeled product. Sales of the climate labeled product rose by 6 percent when the information about the climate certification was provided the consumers. However, the climate label can still only be justified as a policy instrument if the labeling system actually reduces GHG emissions. Another finding in this experiment is that the increase in sales of climate certified milk is due to a substitution effect from mainly organically produced milk, which also has an enhanced environmental quality. This finding suggests that the total environmental impact has not changed much with the information about the climate label provided the consumers.

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Uppsala, June 2013

Elina Matsdotter

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1. Introduction

How is consumer demand of climate labeled food products affected when consumers are being presented information about decreased climate impact of the food product through a certified climate label? Yet, no one really knows. The aim of this thesis is to answer this question by studying the direct effect on sales when a food product is claimed to be climate friendly through a certified climate label on milk. The papers main contributions is supplying the first causal estimate on the effect of a certified climate label on consumers' consumption patterns and to give hints on the effectiveness of climate labeling in mitigating climate impact of food consumption.

The scientific consensus on climate change is that the Earth's climate system is unequivocally warming. According to the Intergovernmental Panel on Climate Change (IPCC), greenhouse gas (GHG) emissions generated as a result of human activities (for example burning of fossil fuels, agriculture and deforestation) are with at least 90 percent certainty the main cause of climate change. The challenge for policy makers is to develop short-term strategies that can bend the global GHG emission curve to buy time, reduce costs and build support for more efficient approaches (SEPA, 2008). To identify economically efficient ways of progressing toward reductions in GHG emission, it is essential to analyze the climate impacts of food products and consumption patterns (see for instance Vandenberg *et al*, 2011).

Food consumption and production accounts for a large proportion of the global GHG emissions (see e.g. Steinfeld *et al*, 2006). According to a study undertaken for the European Commission, 30 percent of the various environmental impacts of private consumption are caused by the food industry (Tukker *et al*., 2006). Current trends in food consumption patterns point toward increased demand for food with large environmental impacts and more environmentally friendly diets need to be identified (Carlsson-Kanyama and Lindén, 2001). Studies have shown that by altering the consumption patterns of food products, the emissions of GHG from food consumption can be substantially lowered (Carlsson-Kanyama, 2004; Carlsson-Kanyama and González, 2009). But, how to change these consumption patterns is not yet recognized.

Policy makers sometimes look to consumer demand for solutions to environmental policy problems. When policy makers set out to directly influence private sector environmental behaviors, via prohibitions, permits or taxes, tensions and conflicts are usually explicit. The provision of information to consumers, through labels and certifications, appears less confrontation and public programs that disseminate information about the environmental attributes of products are becoming an increasingly popular tool of government agencies and organizations. Climate labeling for food products is an example of a voluntary agreement initiative recently introduced by food producers, retailers and labeling organizations all around the world in order to inform consumers, reduce the GHG emissions of the industry, and stimulate energy efficiency throughout the food supply chain (PCF World Summit, 2012).

Skeptics have on the other hand been concerned that such programs may not significantly influence the behavior of consumers and that implementing yet another labeling scheme might be more confusing rather than educational (see e.g. Stern, 1999). Although consumers in market surveys often maintain that they will take into account information on environmental aspects of food products in their purchasing decisions, there has been little empirical evidence of actual behavior along these lines. Nevertheless, changing consumer behavior can make a significant difference to the environment and research can help policy makers understand this behavior. As Leire and Thidell (2005), Thøgersen *et al*. (2010) and Cohen and Vandenberg (2012) emphasize, there is a significant need for a better understanding of consumer response to climate labels.

This is the first study to report results from a randomized controlled field experiment in which the researcher manipulates product attributes, such as labels, in order to estimate demand effects of a climate label across multiple retail stores. According to a recent study of Cohen and Vandenberg (2012), previous related empirical research in the field has relied almost exclusively upon estimating models of demand using observational data of product sales and through consumer surveys with a variety of techniques (and restrictions) applied.

More specifically, the Swedish climate certification on milk from the dairy company *Sju Gårdar* will be studied by performing a randomized controlled field experiment in 17 major chain grocery stores north of Stockholm. Milk is considered to be a suitable consumer good for this study, because there is no significant difference between the taste and use of the various brands, i.e. the good is homogenous. The only thing that justifies the price difference between climate labeled and non-climate labeled milk is thus the extra production costs arising from lowering GHG-emissions from production. Furthermore, the large volume of sales of milk is advantageous and since milk is produced by livestock production it is also a product with high environmental impact.

1.1 Motivation and research question

The main question this thesis seeks to answer is: *How are sales of climate labeled milk affected when consumers are being presented information about decreased climate impact of the food product through a certified climate label?*

For a climate labeling scheme to actually decrease GHG emissions and environmental impact, consumers need to substitute away from more environmentally damaging goods (i.e. non-climate labeled milk) to more environmentally friendly goods (i.e. climate labeled milk). Therefore, it is also of interest to study the potential substitution effects on other milk products such as conventional produced milk and organically produced milk, when consumers receive information that the milk from *Sju Gårdar* is more climate friendly than other diary brands. Furthermore, the thesis will also seek to answer the following sub questions: *Do consumers substitute away from non-climate labeled milk to climate labeled milk when being presented information about decreased climate impact of the food product through a certified climate label? If so, does the substitution mainly occur from conventional milk or organically* labeled *milk?*

The scope of literature in this field is still limited. This study is therefore exploratory and will provide original field evidence of consumer behaviors that can be foundational to an emerging literature discussing the welfare implications and the usefulness of climate labels on food products. The intention of this study is therefore to guide important further research in the field. However, to be able to draw conclusions on the effectiveness of a climate label to mitigate GHG emissions, a broader analysis would need to be conducted that also takes into account the reduction of GHG emissions and implementation costs of climate labeling schemes (Teisl and Roe, 2005; Hogan and Thorpe, 2009). The main focus of this thesis is to study the demand and consumer's behavioral changes of implementing a certified climate label. Studying demand effects usually implies that prices are considered. In this analysis prices of the studied milk products have been constant over the experimental period and will thus not be incorporated in the modeling framework. Neither the policy perspective or trade issues regarding climate labels will be analyzed.

1.2 Disposition

The remainder of this thesis is organized as follows: Chapter 2 gives a historical background about climate labels as well as a description about the Swedish climate labeling scheme. A summary of what identifies an effective climate labeling scheme will be given. In Chapter 3 a theoretical economic background of climate labeling from the consumer perspective will be established by reviews of previous research both theoretical and empirical on the impact of climate labels on consumer demand of food products. Furthermore, Chapter 4 describes the methodology of the study, the experimental design and the model to be estimated and the tests that will be conducted. Chapter 5 analyzes and presents the results of the experiment. Finally, Chapter 6 will discuss the findings and give the concluding remarks of the thesis.

2. Background about the climate label

The world's first climate label (called the Carbon Reduction Label, CRL) appeared 2007 in the United Kingdom (UK). The initiative was founded by the Carbon Trust, a private company set up by the UK government. The launch of the climate label was driven by the governmental target; reduce GHG emissions in the UK by 60 percent from 1990 levels by 2050. Its preliminary aim was to demonstrate the commitment of companies to decrease the GHG emissions of their products (Carbon Trust, 2006). This label, printed on the packet with the Carbon Trust's "black footprint", presents the carbon footprint measurement in CO_2 equivalents and an endorsement by the Carbon Trust (the label is displayed in Appendix I, Figure 3). Companies that choose to place the CRL on products agree to undertake a comprehensive carbon audit of their supply chains and commit to reducing GHG emissions over a two year period. This methodology is referred to as Publicly Available Specification (PAS 2050).

Since then, many other countries have followed in the footsteps of the UK and a wide range of labels addressing a product's climate impact aspects are now appearing. Many private actors and organizations, as well as governments are investing in, or are considering implementations of climate labeling schemes. All around the globe product climate labeling is gaining more interest and companies across all sectors increasingly assess and communicate the environmental and climate impact of their goods and services[1]. Although most consumers might not have noticed them yet, there is a lot going on behind the scenes.

Hitherto, there is no consensus of what kind of labeling scheme that would be most effective in reducing GHG emissions. So far most climate labels have been designed to give quantitative information of how much GHG emissions a product causes during its life-cycle (carbon footprint) according to the PAS 2050 methodology. Other schemes have been designed as a logo or certification indicating that a product is produced with special consideration taken to reduce GHG emissions, where a claim of emissions reduction also may be communicated. The rationale for the certified climate label is to reflect a strengthened and pro -active environmental commitment by the producer.

The Swedish climate label initiative builds on the aforementioned certification system, but differs in one way from all other existing climate label initiatives. This initiative is called Climate Certification of Food (CCF) and was introduced in the Swedish market in 2010 by the major food certification organizations KRAV[2] and Swedish Seal (Svenskt Sigill)[3]. Key industry groups and

[1] For a summary of existing implementations of different climate labeling schemes worldwide see PCF World Summit, 2012.

[2] KRAV is a member of IFOAM and a key player in the Swedish organic market. In 1993 the KRAV organization was approved as a public authority for the control of ecological holdings by the Swedish ministry of agriculture. In 2002 a market research survey revealed that 93 per cent of the consumers in Sweden were familiar with this label (KRAV, 2006).

[3] The Swedish Seal production criteria ensure high food quality, good animal welfare and decreased environmental impact. To make sure that the farmers follow the rules a third party makes regular audits.

food producers have also joined the project[4], as well as The Swedish Board of Agriculture (Jordbruksverket). The approach is to produce a climate certification scheme that can be used as a plug-in-module for existing environmental labels or standards for food production that already sets requirements within environmental protection, animal welfare and social responsibility. Therefore, a fundamental requirement for accreditation in the system is that the operation already has another quality certification, e.g. an eco-certification. The rationale behind this is that climate impact is only one part of the important sustainability issues that must be addressed and that focusing on the climate question alone can lead to sub-optimal solutions (CCF, 2012a p. 2). The criteria are therefore developed to integrate climate measures with other sustainability issues. For example, the criteria promote renewable energy rather than carbon neutral energy, and healthy animals rather than high production.

The CCF standards are divided into 15 regulatory packages for the different food producers[5] and defined by a goal to significantly reduce climate impact of food products, taking into account what is considered practical and economically achievable throughout the food supply chain (CCF, 2012b). By focusing on the most prominent factors with certain large climate impacts, such as use of feed based on soy protein, high consumption of fossil fuels, and production with nitrous oxides instead of chemical fertilizer, the hope is that the CCF initiative will be effective enough to implement. So far, about 50 food products have been certified which include pork, vegetables, eggs, milk, flowers, etc.

Even if the producers have undertaken new production standards, few consumers are yet aware of the climate label. According to an independent project evaluation of the CCF project, a wider participation from the retailers is needed in order to influence consumers to more environmentally friendly consumption patterns (Futerra, 2012). Also, a broader understanding of the market forces and consumer behavior concerning the CCF is desired.

2.1 Important aspects of a climate label

An effective climate label is first and foremost an instrument that indirectly reduces the environmental impact and GHG emissions of food. This can be done in two ways; either by influencing consumer choices to stimulate a move away from products with high environmental impact to less environmentally damaging products, and/or by encouraging producers to identify efficiencies in GHG reduction throughout the supply chain (Vandenberg *et al*., 2011). For example, studies have shown that reducing the consumption of meat and dairy products and substitute with vegetarian alternatives would decrease the climate impact from food consumption drastically (Carlsson-Kanyama and Lindeén, 2001; Carlsson-Kanyama, 2004). A vegetarian meal can cut emissions down 10 percent of those for a normal beef-based meal and 40 percent from those for a meal based on pork (Carlsson-Kanyama and González, 2009). Wallén *et al*.

[4] More specifically, these actors are Milko, Lantmännen, the Federation of Swedish Farmers, Scan and Skånemejerier.
[5] For further reading about the standards please visit http://www.klimatmarkningen.se/regelverket/alla-regler.

(2004) also show that a wise choice within the same product category could minimize GHG emissions, sometimes even more than a change in diet.

The food supply chain is a complex system, which consists of many different stages and actors, e.g. farmers, suppliers, transport companies, producers, retailers, consumers and waste management companies. All these stages and actors generate different environmental impacts, including eutrophication, acidification, ozone layer depletion, as well as an impact on climate change. Most of the GHG emitted within the food chain in Europe is caused by agriculture, accounting for as much as 49 percent of the GHG emissions, followed by the final consumption stage with 18 percent and manufacturing with 11 percent (CIAA, 2007).

Looking at GHG emission from agricultural activities there are many production factors that will influence the total GHG emissions from a food product. Some examples are the type of agricultural soil and its fertility, the climate of the country of origin, the use of fertilizers, the type and amount of energy used at different stages, the type and amount of fuel used for distribution and delivery, the efficiency of the equipment, animal health etc. (Olofdotter and Juul, 2008). Measuring and verifying the GHG emissions of a food product's life cycle involves numerous assumptions. As practice shows, performing such estimations is not always possible or feasible due to sophisticated supply chains, lack of available data, lack of time and financing allocated to the evaluation (Olofdotter and Juul, 2008). This can lead to over- or underestimations which might question the relevance of the assessment. Therefore, implementing a reliable climate labeling scheme which presents the carbon footprint in numbers is significantly challenging.

Boardman *et al*. (2007) and White *et al*. (2007) discuss a wide range of practical issues concerning climate labeling. They identify that a major issue with carbon footprinting methodologies, such as the PAS 2050, is the high implementation costs. It is also of importance that the climate labeling scheme is trustworthy for the consumer. Products with additional quality claims, such as a climate labeled products, allows a producer to engage in opportunistic behavior, especially when the buyer is willing to pay a higher price (Karl and Orwat, 2000). Because of this reason, the market could face problems with "green-washing", i.e. selling a product that seems to be more environmentally friendly than it really is. Third party verification is therefore necessary to guarantee and enhance the reliability and credibility, and hence effectiveness, of the label. In addition to this, the abundant amount of environmentally friendly labels, logos and brands are perceived by consumers as confusing (Van Amstel *et al,* 2008; Cason and Gangadharan, 2002).

A climate label must, therefore, be introduced carefully so that it attracts consumer attention in competition with all the other information such as brands, fair-trade labels, country of origin, different quality labels and nutrition information (Röös and Tjärnemo, 2011; Thøgersen, 2000). If the climate label is able to break through to consumers, it can still only be justified if the labeling system is designed in such a way that it actually reduces GHG emission. If consumers are responsive to the climate information, climate labeling may also encourage producers to invest in low emissions technologies (Hogan and Thorpe, 2009). Low emissions technologies include production processes with lower GHG emissions and abatement equipment. Moreover, climate labeling may be considered to be a demand pull policy option that encourages technical development.

Clearly there are still many obstacles (and opportunities) to handle regarding climate labeling and the research field is still in an early stage. In addition more knowledge needs to be accumulated. In the next chapter, a review of influential research in the field is provided.

3. Literature review

The main focus of this chapter lies in reviewing other studies on the impact of climate labels on consumer demand of food products. Firstly, a review of the theoretical literature will be given and the theoretical economic framework of this thesis will be presented. Secondly, a review of empirical studies concerning the topic at hand will be summarized. Because of the recent birth of climate labeling, the scope of literature in the field is limited. Even though little evidence has yet been generated, much can be learned from studies of similar environmental product labels. Therefore, this chapter also builds upon a review of studies carried out on other environmental labels with similar characteristics. The nature of scientific evidence in the field so far falls into three main categories: (1) theoretical economic modeling; (2) industry and market studies of product sales; and (3) consumer surveys of label awareness, use and stated preferences.

3.1 Theoretical literature review

The economic theory behind the demand for consumer product labels is well established (see for instance Darby and Karni, 1973). A traditional utility-maximizing model of consumer behavior assumes that the rational consumer will choose a combination of price and quality that is consistent with his/her utility function and constraints (e.g. income). An important assumption of utility maximization is that consumers have perfect information about both the price and quality they face. Search attributes, such as prize, color or package of a product, are easily determined whereas credence attributes are not observed either at the point of purchase or through casual experience. The environmental quality attributes of a product are typically in the credence category. For example, it is typically not possible for consumers to distinguish between production processes that have different environmental impacts when the final consumer product is the same (Hogan and Thorpe, 2009).

The role of a climate label is thus to turn a credence attribute into a search attribute so that consumers can easily compare and make more informed utility-maximizing product choice decisions (Karl and Orwat, 1999). Producing a food product with lowered GHG emissions compared to product substitutes enhances the quality of the products. In other words, the climate label will help provide information to enable consumers take into account the environmental damage associated with the products and the increased environmental quality of the labeled good (Hogan and Thorpe, 2009). Hence, labeling may affect behavior by influencing the consumer at the purchase occasion and affect the implicit weights that consumers assign to the different product attributes. If the value of additional information exceeds the cost of search for the consumers, they will demand this information and utilize it in their purchase decisions. Effectively, the climate label decreases the search cost for the information about the increased quality of the good. The consumer demand for information on credence attributes is also predicated on the assumption that consumers know this attribute exists and that it might vary by product. Moreover, to demand information consumers need to know the value of it (Grankvist *et al*., 2007).

Consumer demand for credence attributes, such as a climate label, may be classified as either being "altruistic", i.e. caring for the environment enough to pay for it, or due to the "warm-glow" associated with spending money on environmental protection, i.e. feeling good about giving to the environment (Cohen and Vandenbergh, 2012). However, because of the free riding problem of public goods, one may be skeptical of the whole idea that labels on attributes, that do not yield the consumer significant direct benefits, should have any effect on purchase decisions.

3.2 Theoretical modeling framework

In this section a modeling framework will be established in order to exemplify the mechanisms behind a utility-maximizing decision of a consumer facing information about a certified climate label. By using utility functions in revealed preference approaches for measuring the demand for public goods and product quality it is possible to illustrate how consumers maximize their utility when choosing from a set of alternative products (i.e types of milk) available in a particular market. This theoretical framework is along the lines with consumer welfare theory provided by Smith and Banzhalf (2004).

An important assumption for this theory is *weak complementarity*, i.e. that there is a private good that is consumed with the non-market environmental good[6]. In our case, we assume that the quantity consumed of climate labeled milk (private good) is a weak complement to the attribute of increased environmental quality (public good). To express this concept formally, consider the following case of utility maximization based on the model by Smith and Banzhalf, 2004. Equation (1) defines the utility function where information about the attribute of increased environmental quality is provided to the consumer.

$$U = U(x_i, q_j(x_i)) \qquad i = 1, 2 \qquad j = 0,1 \tag{1}$$

where x_1 is a particular climate labeled products (i.e. *Sju Gårdar* milk) and x_2 is a non-climate labeled product (all other milk products). The enhanced quality of the public good associated with x is denoted as $q_j(x_i)$, which consumers can take into account if they receive this information, represented by q_1. If consumers do not know about the gained environmental quality of the climate labeled milk then q is denoted q_0. An individual must consume a positive amount of the weak complement to gain utility, which means that x_1 is correlated with the environmental quality attribute (q).

[6] The concept of weak complementarity was introduced by Karl-Göran Mäler in 1974.

The utility functions in (1) represent the aggregate indifference curve of all consumers in the market. According to basic neoclassical economic theory, we assume that all consumers maximize their utility, subject to a budget constraint.

$$\underset{x_i}{Max}\ U = U\big(x_i, q_i(x_i)\big) \qquad\qquad i = 1, 2$$

$$s.t.\ \ \sum_{i=1}^{n} p_i\, x_i = M \qquad\qquad (2)$$

where p_i is the price of each product i, and M the available budget of the consumer (income). The optimal solution to this constrained maximization problem is where the marginal rate of substitution (MRS), equals the relative price of the goods. Thus, consumers seek to find combinations of the goods that would keep utility constant at a specified level, holding all other variables constant.

The graph in Figure 1 bellow illustrates how variations in the amount of the public good, q, influence the tradeoff between x_1 and x_2. Each indifference curve in the map holds utility and all other goods constant except the two displayed and the level of q. Thus, as we consider variations in the x_1/x_2 tradeoff, the various indifference curves correspond to different levels of q, i.e. with and without climate information. Weak complementarity, together with x_1 as a nonessential good assures that all the constant quality indifference curves for a given level of utility will intersect the vertical axis at the same point. The "fanning property" of the indifference curves describes, for a given income level, how the choke price pivots about point A with changes in the quality of x_1. These changes measure the pure substitution effect of information about quality changes.

Start with a scenario with no information about environmental quality, so that q_i is equal to q_0, and let mm_0 be the initial budget line. The equilibrium for this utility maximization problem is represented by point *B* in the graph where the slope of the indifference curve $\overline{U}(q_0)$ equals the slope of the initial budget line. With weak complementarity, increases in q from q_0 to q_1 (by providing information through a label) are illustrated by a "fanning" of these indifference curves about the point *A* where the indifference curves originate. When there is no consumption of x_1, (i.e. at point *A*) the consumer is indifferent to changes of environmental impact. With positive levels of consumption of x_1, increases in quality information imply that the indifference curve will shift down to maintain the same utility level. That is, with quality information we assure that progressively smaller amounts of x_1 and x_2 will be required to realize the same utility. This means that the slopes of the indifference curves are steeper with quality information and that the new equilibrium will be at point *D.* Thus, consumers will substitute other milk with climate labeled milk and consume the combinations of $x_1^3\ x_2^3$, i.e. the consumption of climate labeled milk will increase while the non-climate labeled milk will decrease. This theoretical result will be empirically studied in the following chapters.

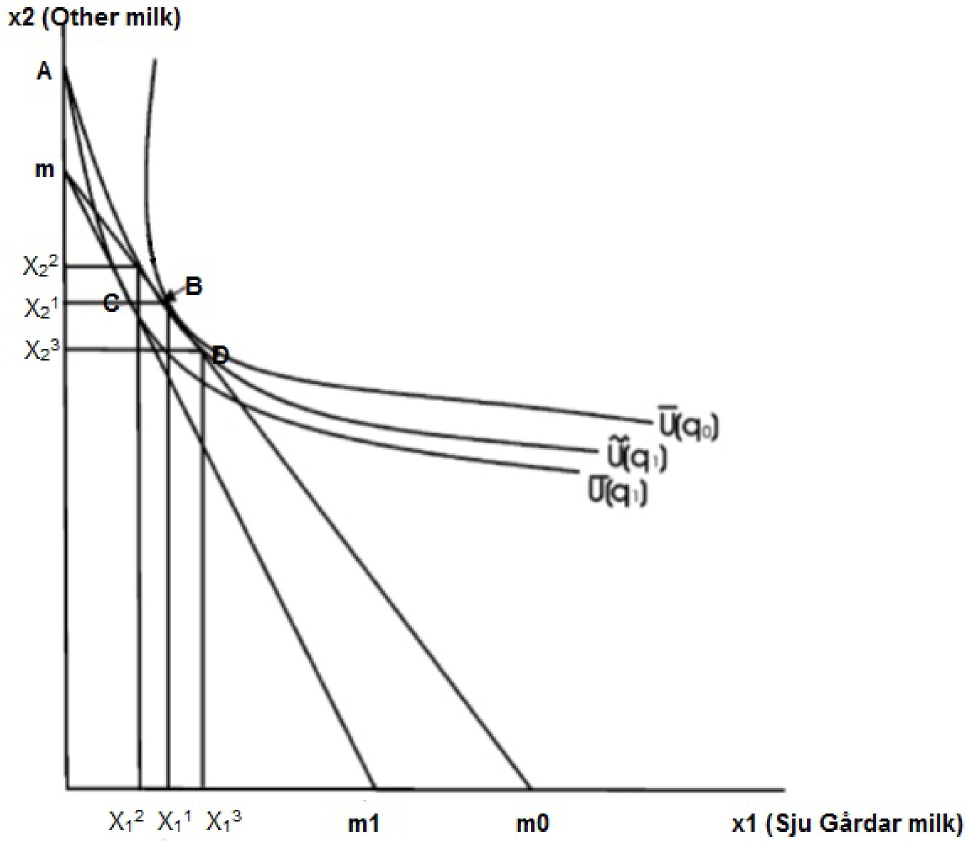

Figure 1. Weak complementary and fanning indifference curves
Source: Smith and Banzhalf, 2004

3.3 Empirical literature review

The evidence from consumer survey research shows that consumers will readily express a willingness to incorporate climate impact information into consumption decisions. Three Swedish consumer survey studies (Toivonen, 2007; Blomqvist, 2009; YouGov, 2010) showed that a very high number of Swedes claim that they would buy climate labeled products if they existed; 73 percent of the respondents in the study by Toivonen (2007), 92 percent in that by Blomqvist (2009) and 74 percent according to a study by YouGov (2010), a leading Nordic market research company. Similar studies performed in the UK are alike to the Swedish ones with regard to the respondents claimed interest in climate labeling of food products (Berry *et al*., 2008; LEK, 2008; Upham and Bleda, 2009; NBS, 2010).

Even though the demand for climate impact information seems to be large, the positive attitudes do not seem to translate into actual behavior. So far, sales of environmentally friendly food products account for a very small share, i.e. there is an attitude-behavior gap (Leire and Thidell, 2005). One explanation for this could be that environmentally friendly consumption suffers from the well-known free-rider problem in which caring for collective responsibilities is judged important overall, but avoided by the individual (Ekelund, 2003). Other explanations for the attitude-behavior gap are examined by Röös and Tjärnemo (2011) where the researcher reviews findings from research on organic food-purchasing behavior and discusses how this can be applied to the new field of climate labeling of food. They conclude that the often higher prices on environmentally friendly products, and that strong habit is governing food purchasing are two of the greatest obstacles which makes changes in consumption behavior hard to achieve. Furthermore, the availability of environmentally friendly products are still low in many places, there is a lack of marketing and information, a potential lack of trust in the labeling schemes and also low perceived customer effectiveness.

Looking at the industry and market studies of product sales, the conclusion seems to be that consumers are responding positively to other environmental labels. Teisl *et al*. (2002) used scanner time-series data on U.S. retail sales to investigate the effect of the "dolphin-safe" label on the overall market share of canned tuna. The results showed that the market share (relative to other canned seafood and meat) rose substantially after the introduction of the "dolphin-safe" label. This was identified through changes in aggregate consumption of tuna before and after the label was introduced. The paper provides market-based evidence that consumers respond to environmental labels. However, as noted by the authors, the lack of cross sectional variation implies a limitation in the data. Thus, it is possible that the significant effect of the "dolphin-safe" label could have been caused by unaccounted market trends (see for instance Hainmüller, 2011).

Bjørner *et al*. (2004) also found empirical evidence of significant changes in consumer demand on toilet paper following the introduction of a certified Nordic Swan label[7]. Even though toilet paper not can be considered a food product is still a fast moving consumer goods (FMCG), just as food, which still makes the results interesting. The study was performed using panel-data of actual purchase behavior for about 1600 consumers between 1997-2001 in Denmark. The toilet paper with the Nordic Swan label had an increased marginal willingness to pay of 13-18 percent. Interestingly, Bjørner *et al*. found little evidence of a higher willingness to pay for paper towels. The authors conclude that this result is due to the fact that there are more environmentally friendly substitutes for paper towels (i.e. cloth) and the most environmentally conscious consumers might not be purchasing the Nordic Swan label as they are less likely to buy any paper towels. This conclusion highlights the importance of considering available product substitutions when studying the impact of labeling schemes.

Although the research of Teisl *et al*. and Bjørner *et al*. examine other forms of environmental labels than climate labels, the results are still interesting. Many studies have concluded that similarities in consumer attitudes exist between climate labels and other environmental labels (e.g. Röös and Tärnemo, 2011; Cohen and Vandenberg, 2012; Hogan and Thorpe, 2009). The

[7] The Nordic Swan label is the official sustainability eco-label for the Nordic countries. It is a voluntary license system where the applicant agrees to follow a certain criteria, including environmental, quality and health arguments, set outlined by the Nordic Eco-labeling in cooperation with stakeholders.

Fair Trade label has, for example, been identified as having common denominators with climate labeling, e.g. both involve consideration for other distant individuals; for Fair Trade the concern is for workers in distant counties and for climate labels with future generations.

Even more interesting, however, is the study over a traffic light carbon label scheme performed by Vanclay *et al*. (2011). The study was undertaken in a regular grocery store in Australia with a demographic similar to the median for the whole country. Thirty-seven products in five product lines of high-volumes sale items (milk, spreadable butter, canned tomatoes, bottled water, and non-perishable pet foods) were labeled to indicate embodied GHG emissions and sales were recorded over a three-month period. Green (below average), yellow (near average), and black (above average) footprints indicated GHG emissions embodied in groceries. These signs are provided in Appedix I, figure 4. The researchers draw media attention to the study, based on an assumption of a need to alert customers about the labels prior to their arrival in store since many grocery store customers are unlikely to loiter whilst shopping. The overall change in purchasing pattern was small, with black-labeled sales decreasing 6 percent and green-labeled sales increasing 4 percent. However, when green-labeled products were also the cheapest, the shift was more substantial with a 20 percent significant switch from black- to green-label sales. These findings illustrate the potential for labeling to influence consumption patterns to stimulate reductions in GHG emissions. Critique of the study is, thus, that the media attention might have given biased results, which the researchers also identify. Weaknesses in the experimental design made it also impossible for the researchers to isolate the effects of the labels from potential time-varying or product specific confounding factors, or to compare the effects of environmental labels with the effects of alternative types of marketing labels, which limits the ability to extrapolate the findings to a broader context.

The most interesting finding from Vanclay *et al*. (2011) is the significant result when the price and carbon signals coincided (i.e. when green-labeled products were the cheapest alternative). This suggests that the combination of a price incentive (via a carbon tax or emissions trading system) and a climate label could be effective in reducing the GHG emissions. This also lends empirical support to the analysis by Rubik *et al*. (2007). Other studies have also identified positive responses for traffic light labeling schemes. For example Berry *et al*. (2008) investigated the perceptions of five types of labels in focus group interviews and came to the conclusion that a traffic light labeling scheme was the most appreciated, since it was familiar and easy to interpret.

Shewmake *et al*. (2011) contributes with the first ever theoretical economic model that predicts how consumers would respond to better information about the GHG emissions in food production through a certified climate labeled. The study is combining information on demand elasticities of food products and information of GHG emissions from LCA analysis, which enables the researchers to quantify the substitution and complementary relationships between products and reduction of GHG emissions. The results show that a climate label could decrease the GHG emissions of food production. The largest reductions would be for a label on meat and alcohol. But uncertainties still exists and the authors highlight that perverse- and spill-over-effects might exists. They also conclude that a comprehensive carbon tax would result in even lower GHG-emissions. Although, a certified climate labeling scheme could be a useful policy instrument before a more comprehensive climate policy is adopted.

Cohen and Vandenberg (2012) identifies that there is a need for rigorous empirical research in the field, which uses random assignment or quasi-experimental methods. Furthermore, the authors claim that such research methods could help identify the causal relationship between climate labels and consumer demand. The only study using a rigorous randomized field experimental method for studying over the impact of certified food labels on consumer behavior is Hainmüller *et al*. (2011). The label considered in the study by Hainmüller *et al*. (2011) is the Fair Trade label on coffee.

The experiment was conducted in 26 stores of a major U.S. grocery store chain and was divided in two different set-ups; one label experiment and one price experiment. In the label experiment the researchers assigned two different 2x2 inch signs (treatment or control) on the coffee bins, using a matched pair design random assignment method with a two-group, two-phase crossover design, whereby stores with similar characteristics were randomly assigned to a sequence of treatment-control or control-treatment. In each store, the treatment or control condition was in place for a period of four weeks, after which stores switched to the opposite condition for another four weeks. Using a random assignment method gives the researchers possibility to exploit within-store and time variations and controlling for external demand chocks.

In the price experiment the intervention involved raising the prices for the Fair Trade labeled coffees. In addition to the price increase, the stores in the treatment condition displayed a 3x3 inch Fair Trade label sign on the bulk bins containing the coffees that carried the message: "A Fair Price to Support Fair Trade". This massage aimed at inducing consumers to connect the higher price specifically with Fair Trade certification. The stores in the control condition, where prices were not altered, displayed a Fair Trade label with the message: "Support Fair Trade". The result showed that sales of the two most popular bulk coffees sold in the stores rose by almost 10 percent when the coffees were labeled as Fair Trade. Overall, the findings suggest that there is substantial consumer support for Fair Trade, although a segment of price-sensitive shoppers will not pay a large premium for the Fair Trade label.

The study by Hainmüller *et al*. (2011) highlights the advantages of using a randomized field experimental approach. Therefore, this study will use the same method in order to gauge the casual effect of a climate label on demand. However, the randomization procedure will not be according a matched pair design in where stores are grouped two by two according to similar characteristic. The randomization method used in this study will be returned to in the next chapter.

5. Method

Previous research on consumer demand for climate labels has not been able to draw conclusions on the causal effect on demand of implementing a labeling scheme. When using empirical market methodologies (as for example Bjørner *et al*., 2004 and Teisl *et al*., 2002) a limitation imposed is that no control group is available and by that no observable cross-sectional variation. Therefore, the researchers are restricted to draw conclusions on the causal effect of the environmental label, since it is impossible to know if other market trends or demand shocks might have been the actual reason for the increased sales of the labeled products. Consumer surveys, focus groups and arranged experiments methodologies are also restricted due to the presents of experimental effect which results in biased results. An experimental effect, or so called Hawthorn effect[8], occurs when the agents know they are being studied and therefore respond in a way they believe the researchers want to achieve.

Therefore, the methodology of this study is to conduct an experiment in a "real-world setting" by performing a randomized controlled field experiment. In that way, the problem with experimental effects can immediately be rejected (Gerber and Green, 2012). A well designed randomized controlled experiment can supply researchers with causal estimates of the effects of a specific treatment on a specific population over a certain time period (Duflo *et al*. 2007). The mechanism behind this methodology will be explained subsequently in next section by following Angrist and Pischke's (2008) disposition.

5.1 Description of method

In essence a randomized controlled field experiments solve the question of identifying an average counterfactual and in turn the causal effect of a treatment. We imagine a state of the world with two potential outcomes where the treatment is a binary variable, $D_i = \{0,1\}$. The outcome of interest being measured is denoted by Y_i. The question is how the outcome, Y_i, is affected by the treatment, D_i. When an agent is exposed to a treatment there are two different potential outcomes for the agent (Angrist and Pischke, 2008):

$$potential\_outcome = \begin{cases} Y_{1i}\_if\_D_i = 1 \\ Y_{0i}\_if\_D_i = 0 \end{cases} \qquad (3)$$

However, since we cannot observe the same outcome of a treatment for the same agent we have to look at averages over a population. When comparing groups of individuals we provide an

[8] The "Hawthorne effect" was established in 1950 by Henry A. Landsberger when analysing older experiments from 1924-1932 at the Hawthorne Works (a Western Electric factory outside Chicago).

average over the agents that have been treated and compare that to the group that not has been treated. The equation then becomes:

$$\underbrace{E[Y_i|D_i=1]-E[Y_i|D_i=0]}_{Observed\_difference\_in\_average\_outcome} = \underbrace{E[Y_{1i}|D_i=1]-E[Y_{0i}|D_i=1]}_{Average\_treatment\_effect\_on\_the\_treated} + \underbrace{E[Y_{0i}|D_i=1]-E[Y_{0i}|D_i=1]}_{Selection\_bias} \tag{4}$$

In practice, the difference in means between treatment and control groups can be obtained from a regression of dummies for each treatment group. In the simplest form of OLS regression framework we can estimate the average effect of treatments over a population with

$$Y_i = \alpha + \beta D_i + \varepsilon_i \tag{5}$$

where Y_i measures the outcome of interest and the error term, ε_i, contains all the additional determinants of the outcome Y_i. The OLS estimator $\hat{\beta}$ is called the *difference estimator* because when the treatment is binary, it is the difference between the average outcome of the treatment group and the average outcome of the control group. Thus, $\hat{\beta}$ reveals the magnitude of the estimated effect of the treatment, the so called *average treatment effect* (ATE).

If the treatments are randomly assigned, then $E(\varepsilon_i | D_i) = 0$ in Equation (5) and the difference estimator $\hat{\beta}$ is regarded as a consistent unbiased estimator (Stock and Watson, 2003). When randomizing treatments we also guarantee that there will be no selection into the various treatment groups and that assignment to treatment is orthogonal of any characteristics of the agents. This solves the problem of selection bias present in equation (4). It also solves the possibility of omitted variable bias. If D_i is randomly assigned, then D_i is distributed independently of the omitted factors in the error term in equation (5). Thus random assignment of D_i implies that the first least squares assumption in the regression framework holds automatically. Furthermore, if the sample is large enough it will be the law of large numbers approximate the normal distribution. Given a large enough sample, and complete randomization of treatments, the researcher is left with a causal estimate of the effect of the treatment on the measured outcome.

However, some threats to internal validity still exist. These include failure to follow the treatment protocol (i.e. non-compliance and/or partial compliance) and attrition (i.e. subjects dropping out of the study after being randomly assigned to the treatment or control group). Furthermore, there are also some threats to external validity to consider. According to Stock and Watson (2003) these threats are:

- *Non-representative sample:* The population studied and the population of interest must be sufficiently similar to justify generalizing the experimental results.

- *Non-representative program or policy:* The policy or program of interest must be sufficiently similar to the program studied to permit generalizing the results.
- *General equilibrium effects:* An internally valid small experiment might correctly measure a causal effect, holding constant the market environment, but general equilibrium effects mean that these other factors are not held constant when the program are implemented broadly.

These threats have been taken into account in the design of the experiment at hand and will also be returned to later in the analysis of the results. But first, an explanation of the experimental set-up and design of this study at hand will be given.

5.2 Experimental set-up

The randomized controlled field experiment will be carried through in all grocery stores of Coop where the dairy products from *Sju Gårdar* are distributed. Coop is one of the major grocery store chains in Sweden and a leader in sales of organic, environmental and fair trade products[9]. Using a major grocery store chain is convenient since the chain covers the spectra of all kinds of consumers with different socioeconomic backgrounds. The stores are also of various sizes, from smaller convenient stores to large super markets, and both located in rural and urban areas. This facilitates drawing conclusions of external validity and extrapolation of the results.

The total number of Coop grocery stores carrying *Sju Gårdar* milk is 17 stores, all located in the Province of Uppland (north of Stockholm) where the experiment will be carried out. This geographical position is convenient since it gives the opportunity to overview and control the experiment allowing that the quality of the study is more guaranteed. A list of all the grocery stores included in the experiment, as well as a map of the store locations is to find in Appendix II. The experiment started on the 6th of April 2013 and ran until the 3rd of May four weeks later.

The milk from *Sju Gårdar* is also organically produced and was one of the first climate certified milk according to the CCF standards, and become certified in June 2010. At that time marketing in the form of local radio and television commercial was aired telling that the milk from *Sju Gårdar* was now climate certified. A total of 20 airings spanning over 14 days were conducted (Johansson, 2013). The milk from *Sju Gårdar* is also locally produced and the only climate certified milk product in the chosen market area of the study. In Appedix II the three different milk packages are displayed (i.e. low-fat: blue package, medium-fat: green package, standard-fat: red package).

Before the experiment was launched a pilot study was conducted in one grocery store in the city center of Uppsala[10]. This store was excluded in the main study. The pilot was performed over 30 days with treatments varying on a daily basis. The treatments of the pilot were in no way similar

[9] Visit www.coop.se for further information.
[10] Ica Supermarket Torgkassen in the central of Uppsala.

to the treatments of this study. Rather the pilot study was a test of the experimental design. The main lesson from the pilot was that, in order to minimize the risk of biased estimates, the treatment should vary on a lower frequency because of the presence of non-compliance in the administrators (i.e. the store personnel) which could threat the internal validity of the experiment. Due to this experience, the importance of easy and constructive instructions to the administrators was also highlighted and the formulation of the instruction sheet could be clearer for the final study. The final instruction sheet does not reveal the full purpose of the study, making the administrators blind to the experiment.

5.3 Description of treatments

Following the same approach as Hainmüller *et al.* (2011) the treatments of this experiment also consist of two different signs, which come in format of 18x13 cm (see Figure 1). These two signs have been randomly introduced in all the 17 stores included in the experiment. The first treatment, D_1, is a placement of a sign in the stores, next to the medium-fat milk from *Sju Gårdar* which is the milk with highest sales, reading "*Sju Gårdar Milk*". This is the control treatment of the experiment and will serve as the counterfactual. Having D_1 as the counterfactual treatment allows gauging the pure marketing effect, which always will be present when diverting the consumers' attention to a product (see for instance Hainmüller, 2011). This is convenient, since the intention of the experiment is to study the effect of information on climate impact rather than the pure marketing effect of introducing a sign. Hence, the second treatment, D_2, is the treatment of interest. Treatment D_2 consist of a sign reading "*Sju Gårdar, Climate certified milk, We decrease our climate impact*". This sign was placed in the same manner as the control treatment.

Figure 2. Treatment D_1 (to the left) and Treatment D_2 (to the right).

The reasoning for the claim about decreased climate impact is due to the certified climate label being recently introduced in the market and very little marketing or information about the CCF standards have been presented. Therefore, few consumers are yet familiar with what the certification implies. Since trust and third party monitoring of a climate labeling scheme is important for a climate label to be effective, additional information in form of a link to the climate certification rules of the CCF standards was also included.

The design of the treatments is crucial for an experiment to be successful (Gerber and Green, 2012). The treatments of this experiment have been designed according to a factorial structure. In other words, the treatments are formed from combinations of levels of sub-treatments, called factors, which makes it possible to determine the pure effect of the additional information (Gerber and Green, 2012). Therefore, the two signs are similar to each other except the additional environmental information. The layout of the signs is consistent with the logo of *Sju Gårdar*[11] and has been designed in accordance with recommendations and inspiration from specialists in the field in order to get a realistic treatment that could be implemented in broader manner even after the experiment[12].

5.4 Randomization of treatments

Random assignment of treatments refers to a procedure that allocates treatments with known probabilities that are greater than zero and less than one. Under complete random assignment, the probability of being assigned to the treatment group is identical for all subjects, i.e the 17 grocery stores (Gerber and Green, 2012). Therefore, treatment status is statistically independent of the different stores potential outcomes and background attributes. The randomization procedure of this experiment has been conducted by setting a random number seed, using the statistical software Stata 12. This enables the randomization procedure to be replicated. The seed as well as the algorithms for this procedure is attached in Appendix III.

The 17 grocery stores were assigned to varying degrees of treatments in approximately normally distributed manner (see Table 1 below). This procedure balances the treatment protocol and the risk that only large stores would receive treatments is avoided. In Appendix II the full protocol over randomizations of treatments is shown. A balanced treatment design also means that we have an equal amount of observations in the control and treatment groups; 34 observations in the control group and 34 observations in the treatment group. The decision to not use a matched pair design (as according to Hainmüller *et al.*, 2011) is due to that necessary information to form blocks was unavailable at the time of the random allocation. The risk of misanalysing the data

[11] Visit www.sjugardar.se

[12] More specifically, Anna Richert and Anders Carlborg (project manager and standard developer CCF), Lars Höök and Elisabeth Gauffin (board of Sju Gårdar), Per Frösslund (marketing consultant), Elin Röös (researcher, SLU), and Mattias Olsson (graphical artist).

would therefore have been large. Arguably, using a matched pair design would not either have yield better precision for this experiment at hand (Gerber and Green, 2012).

Table 1. Approximately normally distributed randomization of treatments

No. of treatments	Freq.	Percent	Cum.
0	4	5.88	5.88
1	16	23.53	29.41
2	28	41.18	70.59
3	16	23.53	94.12
4	4	5.88	100.00
Total	68	100.00	

In order to avoid failure following the treatment protocol, phone calls were made to all stores on the day the signs would be switched. Unannounced visitations to all stores have also been conducted during the treatment period. From these check-ups it is possible to draw the conclusion that we have one (known) case with partial compliance in which the treatment have been switched two days later than what the instructions intended. However, no issues with non-compliance have been detected, i.e. none of the control groups have been treated and everyone in the treatment group has received the treatment.

As expressed previously in this chapter, it is essential that the treatments are assigned in a random manner in order to yield unbiased estimates of the average treatment effect. It is possible to test for randomization by checking whether the randomized treatment dummy actually depends on any individual characteristics of the entities the treatment was assigned to, in this case the various stores (see for instance Gerber and Green, 2012; Stock and Watson, 2007). A test of randomization can advantageously be achieved by using a basic OLS regression with the treatment dummy as dependent variable on the independent variable of “stores”, and test the null hypothesis that all the slope coefficients are zero. Thus, if the treatment is randomly assigned, the assignment will be uncorrelated with the regressor. The result from this regression shows that the randomization was random and that there is no correlation between treatment and store size (see Table 2 below). This dismisses the threat of having failed to randomize treatments and we can be confident that we receive an unbiased estimate of the average treatment effect.

Table 2. Test of randomization

VARIABLES	(1) Treatments
Store	0.000
	(0.000)
Constant	0.500***
	(0.083)
Observations	68
R-squared	0.000

Note: Standard errors in parentheses. * Significant at 10 % level. ** Significant at 5 % level. *** Significant at 1 % level. The dependent variable is a dummy of Treatments.

5.5 Data description

The data used in this study is panel data over daily register sales and revenue from all 17 stores. This data was received from Coops marketing department. The data set includes all kind of milk products the stores offer (in total 73 variables). Due to the aim of this study only the milk from *Sju Gårdar* and close substitutes was kept in the final data-set for analysis. These include low, medium and standard fat milk in all forms of packages and sizes (either 1 liter or 1.5 liter). No extra low fat milk or extra fat milk was considered. Neither was non-lactose milk, milk produced from vegetables (e.g. soy or rice milk) or milk with additives and flavors, such as wellness drinks and chocolate milks.

The final data-set included a few missing values for some of the less sold milk products, e.g. low fat milk products and some of the organic milk products. The reason for this missing values is that some of the smaller sized grocery stores do not carry all milk products. For example Coop Nära in Almunge does not offer any organic milk other than *Sju Gårdar*. Neither does Coop Forum in Norrtälje offer the low-fat milk from *Sju Gårdar*. However, since we can presume the statistical concept called Intention-to-treat (ITT) analysis, this is not a major problem (Gerber and Green, 2012). ITT analysis includes every subject who is randomized according to randomized treatment assignment. It ignores noncompliance, protocol deviations, withdrawal, and anything that happens after randomization. ITT analysis is usually described as “once randomized, always analyzed”. In that way no imputation of missing values would need to be considered. What we want to achieve is an estimate that shows the real picture of the market situation at hand. Nevertheless, it is of importance that the consumers have the opportunity to actually by the product in focus of the experiment. In order to insure that the missing values of sale do not depend on missed out deliveries of *Sju Gårdar* milk data from order and delivery was collected. Furthermore, the data-set was collapsed from daily to weekly observations since the treatments where assigned on weekly basis.

5.6 Modeling framework

The quantities of interest in the analysis are the effects of the experimentally manipulated product characteristics (i.e. the certified climate label) on sales of the climate labeled milk, and on sales of the main alternative milk products that may be affected by substitution. Using the regression framework in equation (5) the model to be estimated is

$$\hat{Y}_{jt} = \alpha + \hat{\beta} D_i + \gamma_j + \delta_t + u_{it} \tag{6}$$

where $i = 1{,}2$ and represents the treatments of interest D_1 and D_2. The unit of treatment, j, will be various grocery stores, so that $j = 1, 2, \dots, 17$. The time unit, t, is weeks, so that $t = 1, 2, 3, 4$. Thus, there are a total of $j \times t = 17 \times 4 = 68$ observations. The outcome variable of interest, $\hat{Y}_{jt}$, will measure average sales of milk per entity of time and the coefficient $\hat{\beta}$ will measure the estimated magnitude of the treatment when D_2 is presented. Since we are using a randomized experimental methodology, no other control variables are necessary (Gerber and Green, 2012). One possible and interesting covariate to include would although be prices of each milk product category. This information would be possible to include since the information is contained in the available data set. The price of the different milk products varies between stores but has been constant during the experimental period. Since it is not necessary to include prices for computing the ATE, this exercise will be a matter for future research.

Given panel data better precision of the estimates can be achieved by treating γ_j as between store fixed effects, so that the identifying variation for the treatment effects is across time based on deviations from store specific means. By also including a set of week fixed effects, δ_t, we can account for weekly demand shocks that are common to all stores, e.g. week three is a salary payment week. Notice that such variations are also directly accounted for via the balanced experimental design and the treatment effect coefficients are therefore unaffected by the inclusion of the week fixed effects. By including fixed effects, we impose time independent effects for each entity (j and i) that are possibly correlated with the regressors. In that way we are estimating the pure effect of the treatment by controlling for the unobserved heterogeneity within the stores and over weeks (Angrist and Pischke, 2008).

Furthermore, in order to study the substitution effects the regression framework in Equation (6) will also be used by considering $\hat{Y}_{jt}$ as the sum of other milk products substitutes of other brands. These milk substitutes of other brands in the 17 stores include Arla and Coops own milk, both conventional and organically produced. In order to study both the total effect on sales as well as the percentage change, the model in Equation (6) also studied taking the logarithm of Y. The results of the regression analysis are presented and further investigated in next chapter.

5.7 Hausman test

In order to receive the highest possible precision of the estimates, a Hausman test was conducted before running the regressions. This test is the generally accepted way of choosing between fixed and random effects in the regression specification (Gerber and Green, 2012). Statistically, fixed effects are reasonable to use with panel data, but may not be the most efficient model to use. Random effects will sometimes give better precision as they are a more efficient estimator.

The Hausman test tests the null hypothesis; that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. If the test is insignificant (Prob>chi2 larger than 0.05) then it is arguably convenient to use random effects. The Hausman test resulted in that random effects would be more suitable (Prob>chi2 = 0.9526). Using random effects will in this case yield a higher precision (smaller standard errors) 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).

6. Analysis and Results

In Table 3, the results from the main regression are presented. Here, the milk product categories have been aggregated over all fat-contents. The three categories are: (1) all climate labeled milk; (2) all organically labeled milk; and (3) all conventional produced milk. The result shows that the information about the climate label has a positive effect on sales of the labeled milk. The first column examines that the average sales of *Sju Gårdar* milk increased by 1.7 percent when the sign with the climate label information was presented. Meanwhile, the sale of the other non-climate certified milk substitutes decreased. This decrease is mainly represented by a decrease in sales of organically produced milk products with a decrease of 4.9 percent compared to conventional produced milk products where the decrease in sales only was 0.1 percent (see column 2 and 3). However, the results are not statistically significant (p-value>0.10).

For the regression on organic milk (column 2), one store is missing. This is due to that one of the smaller convenient stores (Coop Nära in Almunge) does not carry other organic labeled milk that *Sju Gårdar* and when we take the logarithm of zero, this becomes a missing value. The constant represents the average total sales of milk per week over all 17 stores when the control treatment was displayed. The total average sale of climate labeled milk over all 17 stores is about 406 packages when no information about climate certification was presented. This can be compared to the total average sale of 2 636 598 milk packages of conventional milk and about 155 milk packages of organic labeled milk.

Table 3. Main results from the experiment

VARIABLES	(1) Ln Sju Gårdar	(2) Ln Organic milk	(3) Ln Conven. Milk	(4) Sju Gårdar	(5) Organic milk	(6) Conventional milk
Treatment	0.017	-0.049	-0.001	8.223	-8.955	-0.284
	(0.027)	(0.069)	(0.020)	(10.423)	(7.324)	(43.834)
Constant	5.675***	4.686***	7.483***	406.344***	154.757***	2,636.598***
	(0.195)	(0.229)	(0.213)	(112.567)	(39.360)	(669.630)
Observations	68	63	68	68	68	68
No. of stores	17	16	17	17	17	17

Note: Standard errors in parentheses. * Significant at 10 % level. ** Significant at 5 % level. *** Significant at 1 % level. The dependent variable is total sales of each product category (represented by the heading to each column) including all fat contents. Column 1-3 shows the result in log scale and column 3-4 in sales of packages of milk.

In the three last rows of Table 3, the same results are presented but measured in units of sold milk packages per week. Again, we see an increase in sales of *Sju Gårdar* milk when the consumers are presented information about the climate certification. This increase is on average 8 packages of milk per week. We also see a decrease in the other milk product categories, where the sales of organic labeled milk decreased with an average of about 9 packages of milk per week (column 5) and the sales conventional milk decreased with less than 1package of milk per week. Neither of these results is statistically significant on conventional levels.

Nevertheless, since this is the first experiment of its kind, and we have no prior knowledge of the treatment effect, the estimates still provide interesting and substantive significant results. Despite this, we cannot rule out the hypothesis that the average treatment effect of the climate label information is zero. To be able to draw such conclusion a larger sample would arguably be needed since the standard error declines in proportion to the square root of total observations (*N*). This result warrants further investigation.

In order to further investigate the robustness of the average treatment effect and the results above, Table 4 shows the results of a sub sample when only considering the medium-fat milk products. This is convenient since the treatment was displayed in close relation to the medium-fat milk of *Sju Gårdar* because of the large amounts of sales of these products *a priori*. The first column examines the regression result of sales of the climate labeled medium-fat milk on treatment by taking the logarithm on the dependent variable. Sales increased by almost 6 percent when consumers received information about the climate certification. This result is significant on a conventional level (p-value=0.08). Once again, the substitution toward the climate certified milk occurred mainly from the organic labeled milk, although this result is not statistically significant (p-value>0.10).

Table 4. Results from regression with only medium-fat milk

VARIABLES	(1) Ln Sju Gårdar Medium	(2) Ln Conventional Medium	(3) Ln Eco Medium	(4) Sju Gårdar Medium	(5) Conventional Medium	(6) Eco Medium
Treatment	0.059*	-0.008	-0.073	11.278*	-7.675	-8.980
	(0.035)	(0.021)	(0.100)	(6.827)	(28.086)	(6.657)
Constant	5.189***	6.959***	4.145***	251.729***	1,528.382***	89.622***
	(0.196)	(0.209)	(0.221)	(69.711)	(373.662)	(21.818)
Observations	68	68	63	68	68	68
No. of stores	17	17	16	17	17	17

Note: Standard errors in parentheses. * Significant at 10 % level. ** Significant at 5 % level. *** Significant at 1 % level. The dependent variable is total sales of each product category (represented by the heading to each column) including only medium-fat content. Column 1-3 shows the result in log scale and column 3-4 in sales of packages of milk.

Due to the pro-announcement of placing the signs in close relation to the medium-fat milk of *Sju Gårdar* it is also of interest to study the potential differences between the three products from *Sju Gårdar* with different fat-contents. Table 5 bellow examines the results from this regression analysis. Interestingly, while the sales of the medium-fat milk increased with the climate label information the sales of the standard-fat milk decreased with 11 percent, which is a result that is significant at a conventional level (p-value=0.036). This result raises the question weather the color of the sign might have had an effect to influence consumers? Maybe some consumers associated the medium-fat milk to be the only climate certified milk of the three milk product from *Sju Gårdar* (even though all three of them are certified) due to the color of the medium-fat milk coinciding with the treatment sign and therefore choose to buy the medium-fat milk instead of the standard-fat milk?

Table 5. Results from regression on only *Sju Gårdar* milk products.

VARIABLES	(1) Ln Sju Gårdar Low	(2) Ln Sju Gårdar Medium	(3) Ln Sju Gårdar Standard	(4) Sju Gårdar Low	(5) Sju Gårdar Medium	(6) Sju Gårdar Standard
Treatment	0.042	0.059*	-0.111**	1.371	11.278*	-4.480
	(0.079)	(0.035)	(0.053)	(3.346)	(6.827)	(3.976)
Constant	3.528***	5.189***	4.264***	56.932***	251.729***	97.711***
	(0.315)	(0.196)	(0.201)	(17.681)	(69.711)	(26.199)
Observations	63	68	68	68	68	68
No. of stores	16	17	17	17	17	17

Note: Standard errors in parentheses. * Significant at 10 % level. ** Significant at 5 % level. *** Significant at 1 % level. The dependent variable is total sales of each product category (represented by the heading to each column) including all fat contents. Column 1-3 shows the result in log scale and column 3-4 in sales of packages of milk.

6.1 Validity of the results

It has been possible to investigate threats to internal validity in close proximity due the choice of location of the experiment. No attrition or non-compliance has been present in this experiment. It is therefore possible to draw conclusions about this particular sample. But even though an internally valid experiment might correctly measure a causal effect, general equilibrium effects might be a concern if the treatment was implemented broadly. In order to generalize the findings of this study to other populations it would be preferable to replicate the experiment in other locations.

Due to the choice of performing the experiment in a major grocery store chain the risk of drawing a non-representative sample has been minimized. Nevertheless, the customers visiting other grocery chains might differ since Coop offers a broad selection of organically produced food products. The geographical position can also affect the external validity. Many of the smaller stores in the experiment were located in the city of Uppsala, one of the major university cities in Sweden. If students are more concerned about environmentally friendly consumption than other consumers, it would be difficult to draw conclusions concerning a broader population. It can also be that students have less money to spend on food and therefore the result might be hard to extrapolate. Many of the stores in the sample were also located in rural areas and in locations where a car is necessary for transportation to and from the store (few students have cars). It is also important to bear in mind that the food product in focus of this study is only sold in this particular region, which makes it impossible to say anything about the external validity of sales of this particular product in other markets.

7. Discussion and concluding remarks

The purpose of this study was to study the direct effect on demand when a milk product was claimed to be climate friendly through a certified climate label. The main research question to be answered was: *How are sales of climate labeled milk affected when consumers are being presented information about decreased climate impact of the food product through a climate label?*

The first key finding of this experiment is that the climate certification has, in fact, a positive effect on sales of the labeled product. Sales of the climate labeled medium-fat milk rose by almost 6 percent when the information about the climate certification was provided for the consumers. In consumer survey research, a by far greater extent of Swedish consumers' claim they would buy climate labeled food products if they would receive this information. However, this large expressed demand does not seem to translate into actual demand, which strengthens the hypothesis about an attitude-behavior-gap and also highlights the weaknesses of market survey methodologies. The increase in sales of about 6 percent, thus, coincides with the effect of sales in previous research of other environmental labels. As for example Hainmüller *et al*. (2011) found that the sales of Fair Trade certified coffee rose by 10 percent and Vanclay *et al*. (2011) found that a green carbon label increased the sales of 4 percent when information was provided the consumers.

If the climate label is able to break through to consumers it can still only be justified as a policy instrument if the labeling system is actually reducing GHG emissions. In this case, consumers need to substitute away from conventional produced milk toward climate labeled milk for the label to be effective. Furthermore, this study aimed to answer the following sub questions: *Do consumers substitute away from non-climate labeled milk to climate labeled milk when being presented information about decreased climate impact of the food product through a climate label? If so, does the substitution mainly occur from conventional produced milk or organic labeled milk?*

The second key finding from this experiment is that the increase in sales of the climate certified milk is due to a substitution effect from mainly organically produced milk, which also has an enhanced environmental quality. It seems like the segment of "green consumers" receive a greater worth for the money spend on milk when the information about climate certification is provided. This consumer segment already has an expressed demand for caring for the environment enough to pay for it (altruistic consumers), and have re-optimized their consumption accordingly. This finding suggests that the total environmental impact from milk consumption have not changed much with the information about the climate certification. This finding also gives a hint that the effectiveness of climate labeling in mitigating GHG emissions of food consumption might not be that large.

Furthermore, the finding also strengthens the results of Röös and Tjärnemo (2011) where the researchers conclude that the greatest obstacles for a success of a climate labels is that strong habits are governing food consumption decisions. Altruistic consumers that usually buy environmentally friendly milk seem to be easier to influence than consumers that habitually buy conventional produced milk that also lies in a lower price category. Röös and Tjärnemo (2011) also points out that the higher prices on the climate certified product is another obstacle. It might be that, in order to change the behavior of the majority of consumers, the climate certified product would also need to be within the cheapest product category, i.e. lower in price compared to the conventional produced milk. This finding is also supported by the study of Vanclay *et al*. (2011).

An unexpected finding from this experiment is that the color of the climate label information seems to have influenced the purchase decision of the consumers. This result gives a hint that color systems arguably could be useful when designing a climate labeling scheme. However, this experiment was in no way designed to study this inquiry. Rather it was an unexpected result. Further research would need to be conducted in order to draw more precise conclusions. Nevertheless, this finding is supported by the study of Vanclay *et al*. (2011) where the researchers used a traffic light carbon label scheme and found that the color system had influence over consumer behavior. Berry *et al*. (2008) also came to the same conclusion, by investigating the perceptions of five types of labels in focus group interviews. A suggestion for further research is therefore to conduct an experiment in the same manner as the experiment at hand but instead introduce a color traffic light scheme. Such an experiment would perhaps be interesting to conduct on food products that have been identified by Shewmake *et al*. (2011) to yield the largest decrease of GHG emissions, namely on meat and/or alcohol.

Through this experiment, a first step has been taken in trying to establish the causal effect that providing information through a certified climate label would have on the sales of milk. A further step would be to incorporate prices in the experiment in order to study the marginal willingness to pay for climate certified products. An interesting aspect for future research would also be to incorporate micro data on individual consumer level. In that way, it would be possible to draw more precise conclusions on who is affected by the treatment which would facilitate generalizing of the experimental results. More product categories as well as different labeling schemes could advantageously also be studied in the same manner.

Climate labeling schemes are being developed in several countries across the world. An important challenge is to ensure that climate labeling, if implemented, would represent a cost effective instrument in mitigating GHG emissions and a contribution to climate change policy. Implementing a reliable climate labeling scheme has been identified to be significantly challenging and implies, in most cases, high implementation costs. Therefore, it is of high importance that the understanding of consumer response to climate labels is being further investigated. In order to study the full effectiveness of a climate label in mitigating GHG emissions a cost benefit analysis could be conducted in which the cost of implementing a labeling scheme can be compared to the benefits from a social welfare perspective. It is likely that such evidence would be welcomed by policymakers, since this sort of policy tool may be easier to implement and enforce than explicit production site regulations and economic policy instrument such as taxes, permits and prohibitions.

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Appendix I – Example of climate labels

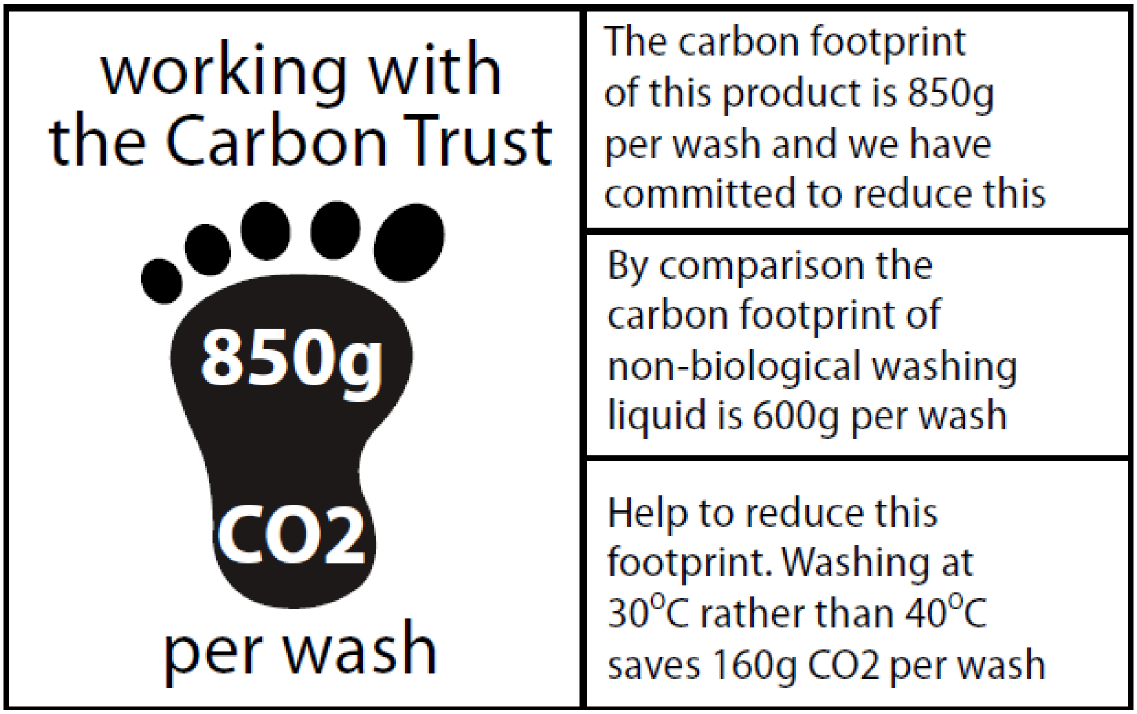

Figure 3. The carbon reduction label provided by the Carbon Trust

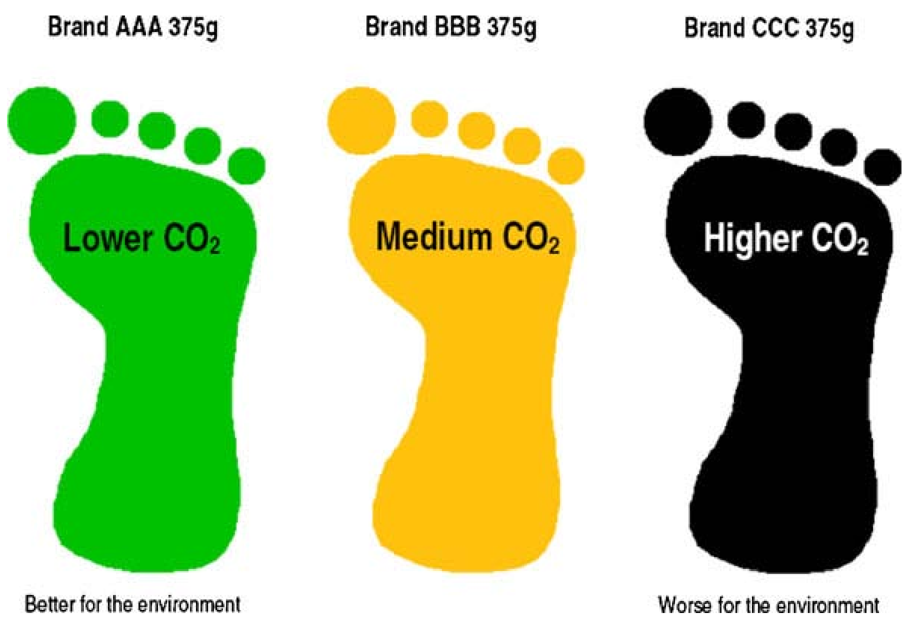

Figure 4. Labels used in Vanclay *et al*. (2011) to indicate carbon footprints of grocery items.

Appendix II – Experimental features

Table 6. List of grocery stores included in the experiment

Butiksnamn	Address	Ort	Tel.
Coop Extra Gränby	Marknadsgatan	Uppsala	010-741-2640
Coop Forum Uppsala Boländerna	Rapsgatan 1	Uppsala	010-74128 20
Coop Konsum Ringgatan	Ringgatan 31	Uppsala	010-741-2590
Coop Konsum Torbjörnsgatan	Torbjörnsgatan 2	Uppsala	010-741-2882
Coop Konsum Västertorg	Västertorg 1	Uppsala	010-741-2580
Coop Konsum Storvreta	Ärentunavägen 10	Storvreta	010-741-2680
Coop Nära Sunnersta	Sunnerstavägen 40	Sunnersta	010-741-2490
Coop Nära Ekeby	Köpenhamnsgatan 2	Uppsala	010-741-2570
Coop Nära Liljegatan	Liljegatan 1	Uppsala	010-741-2540
Coop Nära Almunge	Almungevägen 218	Almunge	010-741 27 60
Coop Konsum Hallstavik	Gottstavägen 6	Hallstavik	010-741 24 10
Coop Forum Norrtälje	Estunavägen 20	Norrtälje	010 - 741 24 60
Coop Konsum Östhammar	Klockstapelgatan 1	Östhammar	010 - 741 27 23
Coop Konsum Öregrund	Strandgatan 30	Öregrund	010-741 27 30
Coop Konsum Rimbo	Köpmannagatan 6	Rimbo	010 - 741 24 20
Coop Forum Stenhagen	Herrhagsvägen 1	Uppsala	010 - 741 25 00
Coop Konsum Uppsala Entre	Stationsgatan 16	Uppsala	010 - 741 84 70

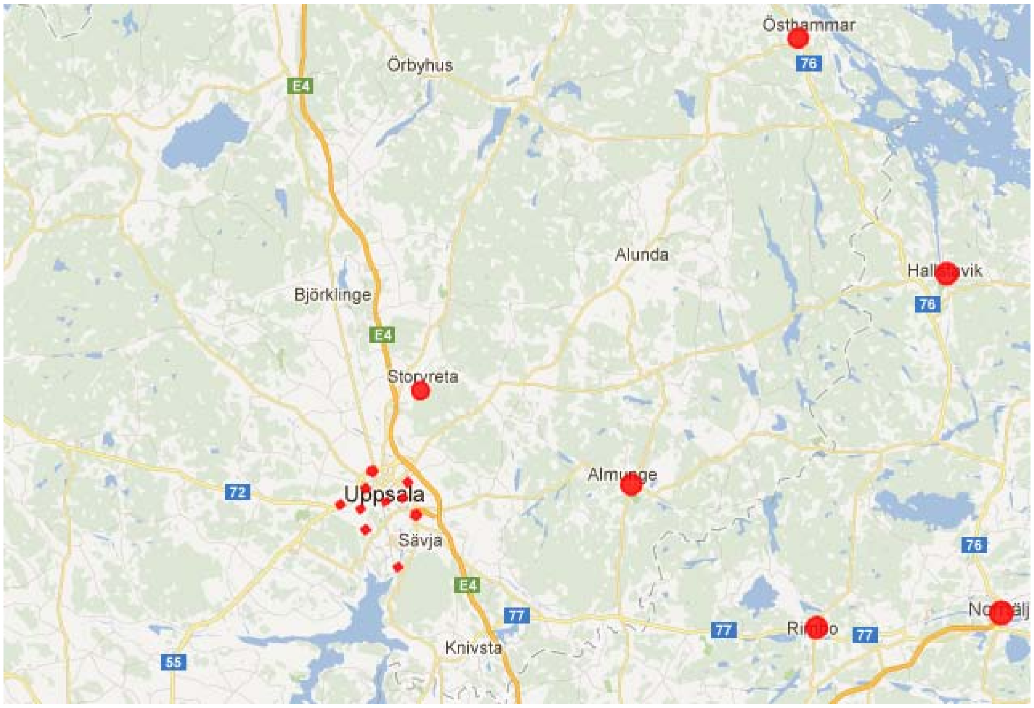

Figure 5. Map over store locations (see the red dots)

Figure 6. The three milk packages from Sju Gårdar. Red: standard-fat milk, Green: medium-fat, Blue: Low-fat (Source: www.sjugardar.se).

Table 7. Randomization scheme of treatments over shops

Shop name	Shopnr	week1	week2	week3	week4
Coop Forum Uppsala Boländerna	1	Sign 2	Sign 2	Sign 1	Sign 1
Coop Forum Norrtälje	2	Sign 2	Sign 1	Sign 1	Sign 1
Coop Forum Stenhagen	3	Sign 2	Sign 1	Sign 2	Sign 2
Coop Extra Gränby	4	Sign 2	Sign 1	Sign 2	Sign 1
Coop Konsum Ringgatan	5	Sign 1	Sign 1	Sign 2	Sign 1
Coop Konsum Torbjörnsgatan	6	Sign 1	Sign 2	Sign 2	Sign 2
Coop Konsum Västertorg	7	Sign 2	Sign 1	Sign 1	Sign 2
Coop Konsum Storvreta	8	Sign 1	Sign 2	Sign 2	Sign 2
Coop Konsum Hallstavik	9	Sign 2	Sign 1	Sign 1	Sign 2
Coop Konsum Östhammar	10	Sign 2	Sign 2	Sign 2	Sign 2
Coop Konsum Öregrund	11	Sign 1	Sign 2	Sign 2	Sign 1
Coop Konsum Rimbo	12	Sign 1	Sign 2	Sign 1	Sign 1
Coop Konsum Uppsala Entre	13	Sign 1	Sign 1	Sign 2	Sign 1
Coop Nära Sunnersta	14	Sign 2	Sign 1	Sign 2	Sign 1
Coop Nära Ekeby	15	Sign 1	Sign 1	Sign 1	Sign 1
Coop Nära Liljegatan	16	Sign 2	Sign 1	Sign 1	Sign 2
Coop Nära Almunge	17	Sign 1	Sign 2	Sign 2	Sign 2

Appendix III – Stata features

The preceding text represents the STATA-code which was used to obtain the assignments of treatments to weeks in stores. This code has been included in order to make it possible to replicate the randomization procedure.

```
/* Sets seed so that randomization procedure may be replicated*/
set seed 11331422

/*Set observations equal to number of shops included in the experiment*/
set obs 17
gen store=_n
sort store

/*Generate the randomized sequence of numbers which helps assign stores to different treatments*/
gen u=uniform()
sort u

/*Shops are assigned to varying degrees of treatments in approximately normally distributed way*/
egen c=seq(), from(1) to(17)
gen sumtreat=0 if c>=1 & c<2
replace sumtreat=1 if c>=2 & c<6
replace sumtreat=2 if c>=6 & c<13
replace sumtreat=3 if c>=13 & c<17
replace sumtreat=4 if c>=17

/* Now treatments are randomly assigned within the spectra of four weeks in the shops*/
gen treat1=uniform()
gen treat2=uniform()
gen treat3=uniform()
gen treat4=uniform()

drop u c
reshape long treat , j(week) i(store)
sort treat
egen b=seq(), from(1) to (4) by(store)
gen q=0
replace q=1 if b==1 & sumtreat==1
replace q=1 if b==1 & sumtreat==2
replace q=1 if b<=2 & sumtreat==2
replace q=1 if b<=3 & sumtreat==3
replace q=1 if b<=4 & sumtreat==4
sort store week
```

```
egen wk=sum(q), by(week)
tab wk
reshape wide sumtreat treat wk b q, j(week) i(store)
```

Results from Hausman test

Test the appropriateness of the random-effects estimator (xtreg, re)
hausman fixed

```
                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed          .          Difference          S.E.
-------------+-------------------------------------------------------------
  treatments |    11.32692     11.27799        .0489318         .823884
---------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        0.00
                Prob>chi2 =      0.9526
```