Intersect, Vol 8, No 2 (2015)

College Students' Emissions "Foodprint": Can Eco-Labels Shift Diet Types?

Michelle Nacouzi
U.C. Berkeley

Abstract

In the context of a rapidly warming planet, it is imperative that consumers shift their diets away from food products with high greenhouse gas emissions. One possible method of encouraging this shift is eco-labeling of products in grocery stores. Here, I explore the consumer impacts of eco-labels, specifically focusing on college students because of their impressionable age, to better understand the extent to which eco-labels affect college students' purchasing and diet choices. This study uses locality and food miles as an indicator to consumers of a food's sustainability. Select products in a sustainable foods grocery store near the UC Berkeley campus were labeled as "Green" (local), "Yellow" (semi-local), or "Red" (foreign) based on product origin. Difference in difference calculations compared the change in sales volume of labeled products (the treatment group) to the change in sales volume of unlabeled products (the control group, estimated using the other products available in the store). The analysis found statistically significant decreases in sales of all labeled products. The conclusion is that students tend to purchase fewer products when those products are labeled by a tiered system of environmental impact. One potential reason for this shift is aversion to sustainability information, a consequence of the plethora of different labeling and certification systems that crowd product packaging in stores. These findings have implications for ongoing and future efforts to communicate product sustainability information to consumers in order to effect change in diets.

Introduction

Globally, food production and transport is the consumption category that contributes most to global greenhouse gas emissions (Hertwich & Peters, 2009). Of the different consumption sectors, agriculture accounts for about 15% of total global anthropogenic emissions, mainly composed of methane and nitrous oxide (Popp, Lotze-Campen, & Bodirsky, 2010). Of the greenhouse gas (GHG) emissions from agriculture, 35% comes from livestock production (McMichael et al., 2007). Consequently, shifting diets away from livestock products can lead to a meaningful decrease in GHG emissions (Garnett 2009, Hertwich and Peters 2009, McMichael et al. 2007, and Popp, Lotze-Campen, & Bodirsky, 2010). Other sources of emissions from agriculture are less significant; in fact, despite the popularity of the "local food" movement, food miles are a relatively poor indicator of the environmental impacts of food production (Edwards-Jones et al., 2008). Locality can indicate length of transport, but it does not distinguish between types of transport (e.g. by air, land, or water), which vary widely in per-mile ecological footprint.

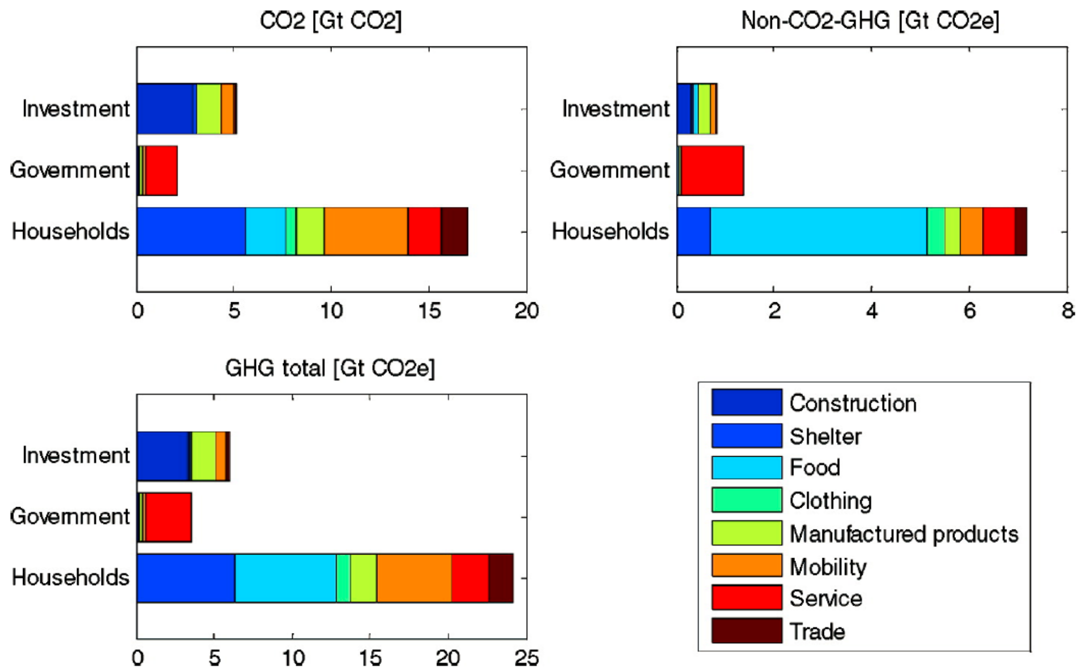

FIGURE 1. Global CO2 and non-CO2 greenhouse gas footprint for different consumption categories and users (Hertwich & Peters, 2009).

Replacing Livestock Foods in the Diet

Demand for meat and milk is set to double by 2050 (Fig. 2). While technological innovations are vital for increasing livestock production efficiency (Garnett 2009), substantial reductions in animal product consumption are needed to achieve the necessary emission cuts (McMichael et al., 2007). Lifecycle assessments have shown that GHG emissions arising from plant-based foods tend to be lower (Garnett, 2009), making the shift to a plant-based diet a favorable goal. Although animal products are important sources of protein and other essential nutrients, vegetarian meals offer the same nutrition as those based on animal products but at considerably less GHG expense (Garnett, 2009). In addition, feeding a population on a diet of animal protein requires an order of magnitude more farmland than does a diet of plant protein (McMichael et al., 2007). To prevent increased (or encourage decreased) GHG emissions from the livestock production sector, average worldwide consumption levels of animal products must be reduced (McMichael et al., 2007). Thus, it is important that consumers shift their diets away from high-emission foods, including meat and dairy.

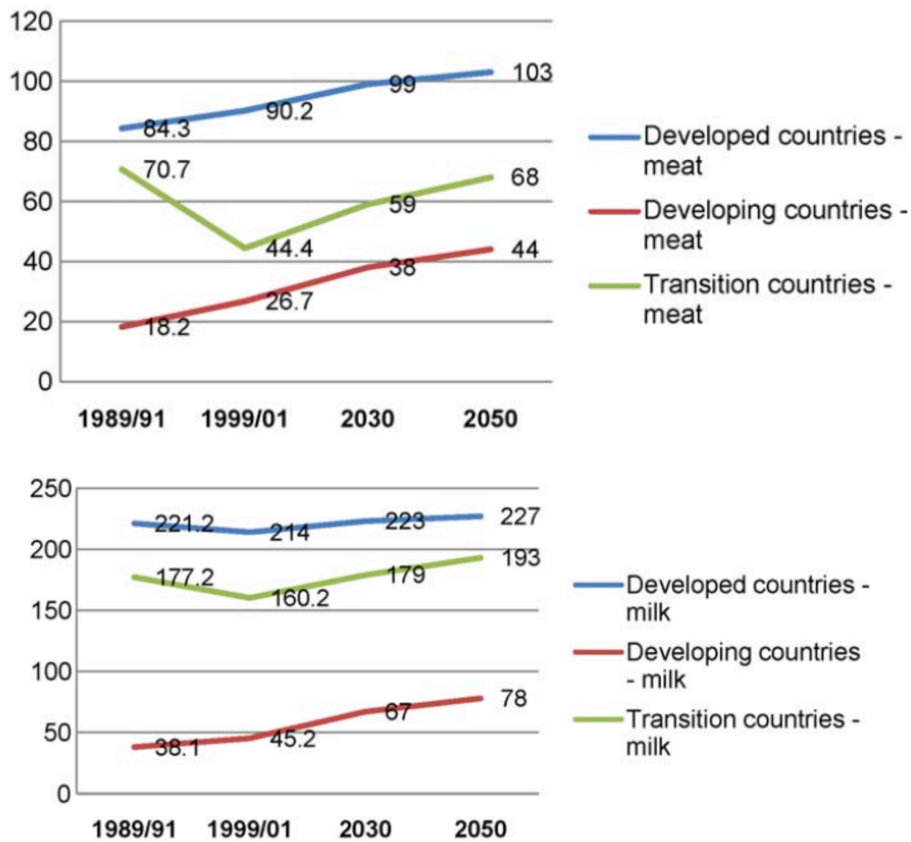

FIGURE 2. Projected trends in per capita consumption of meat and milk products to 2050 (kg/person/yr) (Garnett 2009).

Using Labels to Influence Diets

One effective method of impacting diets is labeling food products, because consumer purchases can be heavily influenced by product label messages (Roe & Teisl, 2007). While product assessment requires considerable effort on the consumer's part – including collection, comprehension, and computation of information – labels can simplify the process for shoppers by making certain information more readily available, thereby increasing consumer knowledge of product characteristics (Russo et al., 1986). However, not all labels adequately serve this purpose. To make choices, "consumers require accurate, standardized, and comprehensible information" (World, 2004, p.7). In general, short and succinct label claims are preferred to long and complex claims (Bushman, 1998).

Consequently, many labeling programs utilize a symbol or system of symbols to communicate information to consumers. For example, the FishWise labels at Whole Foods Market (which assess seafood sustainability) display the fish type and description, the price, and a colored logo representing the product's sustainability grade (Fig. 3).

FIGURE 3. Example of an eco-label used at Whole Foods Market to measure seafood sustainability. (Taken at the Yulupa Avenue Whole Foods in Santa Rosa, CA on May 7th, 2013.)

When assessing consumer responses to eco-labels, it is more important to effectively communicate label information than to ensure that the label information is precise. Vanclay et al. (2010) conducted a study on consumer response to eco-labels using green, yellow, and black labels to relay information on carbon emission levels of food products, but purposefully overlooked complicated variables (like carbon offset arrangements) when assigning colors; the labels were "fit-for-purpose to monitor consumer response," as the study focused on consumer response rather than the precision of GHG calculations and labels (Vanclay et al., 2010). Effectively testing the effects of labels on purchasing does not necessarily require excessive attention to the accuracy of eco-labels, as consumer responses are the primary effect being measured.

College Students as a Target Consumer Group

In order to create large-scale, impactful, and long-term diet shifts, an impressionable consumer population is key. Of particular interest are college student consumers, because eating habits established during college-age years are difficult to break later in life (Levi, Chan, & Pence, 2010). Therefore, if college students can be influenced to shift their diets, this shift can create lasting ecological benefits. Additionally, students rely heavily on detailed product labels in making purchasing decisions (D'Souza et al., 2006), so they are likely to use eco-labels because they are searching for more product information. College students are easily influenced, are at a pivotal age, and rely on product labels, thus making them the ideal targets for eco-labels that aim to shift diets.

Research Question

This study aimed to test the responsiveness of college students to eco-labels. Prior studies suggested that effective labeling systems are succinct and informative; this study aimed to use that existing research to implement a successful labeling system that would gauge the effectiveness of using eco-labels to alter college students' diets, and to assess their willingness to change consumption. (Effecting change towards plant-based diets is of particular interest for future application.) The main research questions considered here are:

- Do eco-labels influence purchasing choices of college students?
- Do diets appear to shift away from or towards unsustainable products?
- What are the magnitudes and direction of change, if any?

Expected Findings

Two pre-existing studies on eco-labeling of food products find little to no effect of eco-labels on sales (Vanclay et al., 2010 and Villas-Boas & Hallstein, 2013). Both studies used a three-tiered colored label: one study focused on products' carbon emissions levels, and the other focused on seafood sustainability (Vanclay et al., 2010 and Villas-Boas & Hallstein, 2013). Both found no significant changes in sales of green- and red-labeled products. One study found significant decreases in sales of yellow-labeled products (Villas-Boas & Hallstein, 2013).

I expected Food Collective sales to experience no overall change across all colors, and predicted that consumers might shift preferences between colors but would not buy different food products to avoid the colored labels. The Food Collective is small, with a limited product selection, so customers have fewer product alternatives to switch to. However, I hypothesized that diets would shift away from unsustainable products (at least temporarily, while labels were present) because the average customer at the Food Collective is highly concerned by ecological impact. I expected green (sustainable) product sales to increase slightly and red (unsustainable) product sales to decrease slightly as compared to the control (Fig. 4). I expected that yellow-labeled products would not change significantly. I didn't expect any of these changes to be very large, as college students have strict budgets and therefore relatively elastic demands.

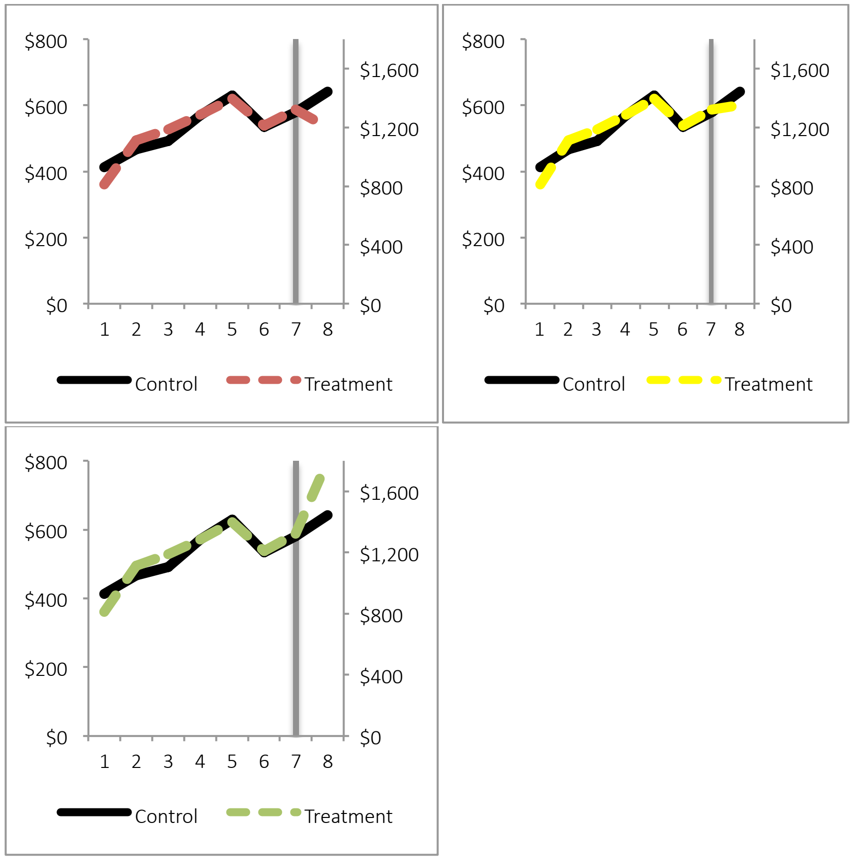

FIGURE 4. Sample of expected findings. Here, red and green sales for Week 8 (the fictitious treatment period) are significantly different from the control.

Methods

Site Description

This study was conducted at the Berkeley Student Food Collective during the Spring 2014 semester. The Food Collective is a non-profit, student-run grocery store located across the street from the University of California, Berkeley campus (Fig. 5) where students and community members can buy to-go items as well as weekly groceries. Because of the proximity to campus, the majority of customers are campus affiliates and so Food Collective sales closely follow the trend of school breaks, midterms, move-outs, etc. The store is 600 square feet and only carries food that meet local, fair trade, ecologically sound, and humane standards. Because of the strict purchasing guidelines, the Berkeley Student Food Collective does not carry very many products that contain meat ingredients. Thus, the study was done using another well-understood indicator of sustainability that was easier to implement: food miles. As previously explained, the effect of eco-labels is the relevant measurement in this case rather than the indicator(s) used. Although this study could be more accurate if actual GHG emissions per product was used to index, the aim is to understand the effects of tri-colored labeling on purchasing decision making, so the communication process was more important than the accuracy of the labels. Findings from this study can be applied to eco-labeling that uses other measures of sustainability.

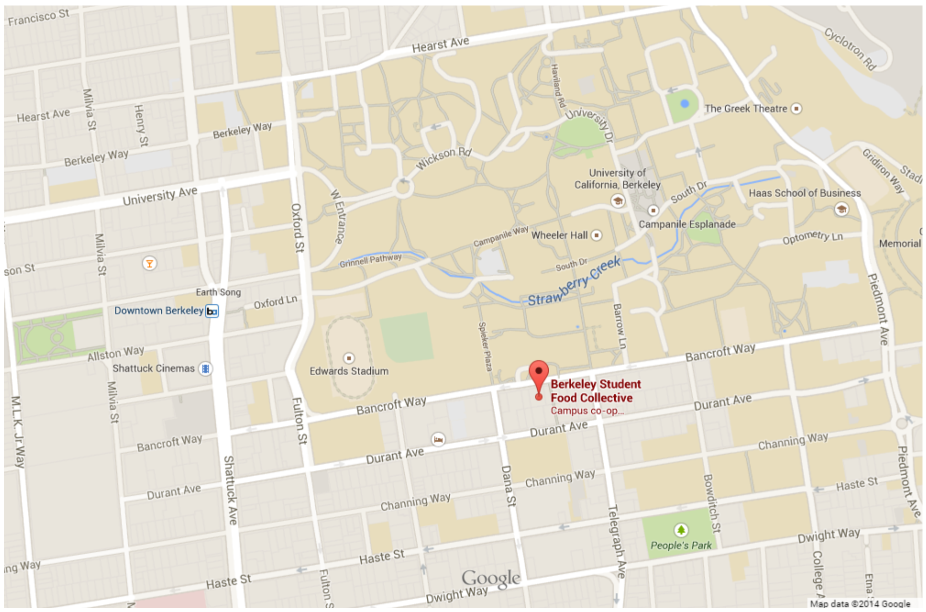

FIGURE 5. The Berkeley Student Food Collective is conveniently located on the south side of UC Berkeley campus (from maps.google.com).

Color Index and Label Design

The first step was to design the product labels and create a color index. Products were designated as "red", "yellow", or "green" based on how far they traveled in food miles – i.e. local products were green, semi-local products (mixed sourcing from USA and abroad) were yellow, and foreign products were red. . The design of the labels was simple, with large color blocks and succinct descriptions to make them easy to read (Fig. 6). An explanatory sheet, including instructions for opting out, was posted in the middle of the bulk section at eye level.

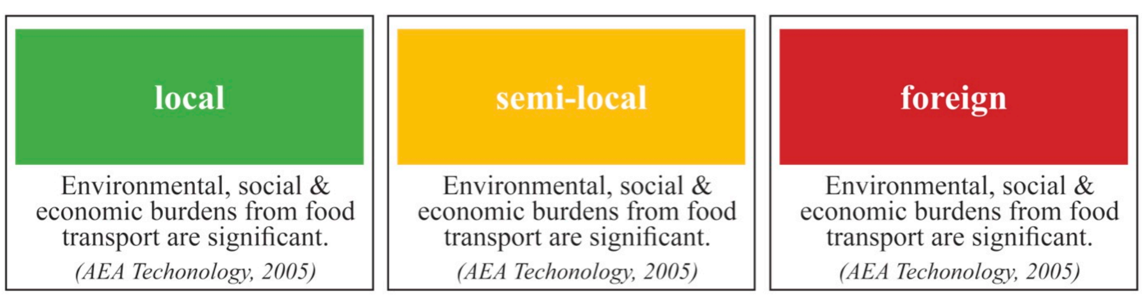

FIGURE 6. Tri-colored labels designed to communicate the varying sustainability of bulk products at the Food Collective.

Data Collection

I chose to use the 39 food products in the bulk section of the store as my treatment products for the labels (Fig. 7). The main reasons for this methodology were that with this approach: (1) the product assortment remained relatively constant; (2) the inventory remained almost fully stocked; and (3) the bins in which the food was stored provided a surface to clearly and noticeably display labels. Not all products in the store fulfilled these criteria, and all other products (non-bulk) were used as the control group. I collected data during the entire Spring 2014 semester, which was 15 weeks long (Fig. 8). January 20 through April 6 were the pre-treatment weeks, and April 7 through May 4 were the treatment weeks. To filter for college students from all the Food Collective customers, I asked the IT Coordinator to set up an automated question at checkout so that cashiers would ask customers about their student status and the answer would get recorded in the Point of Sales (POS) system. That process assigned the "student" label to relevant transactions.

FIGURE 7. All products in the bulk section were labeled with the tricolor scheme, while other products in the store were not. (Taken at the Berkeley Student Food Collective on April 6th, 2014.)

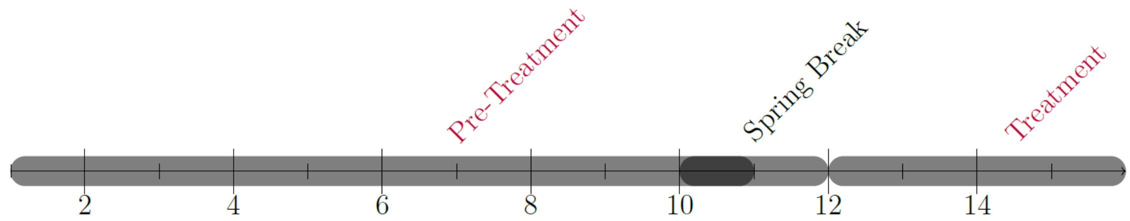

FIGURE 8. This timeline depicts the Spring 2014 semester, numbered by weeks. Weeks 1-11 were the pre-treatment period when no labels were up, and weeks 12-15 were the treatment period when all bulk products were labeled. Week 9 was Spring Break, when students leave the University and all sales drop drastically.

Data Analysis

After the data were collected, I performed difference in difference calculations (Fig. 9) to determine if changes in treatment group sales data were significantly different from changes in control group sales data. I did these calculations for red, yellow, and green labeled products using the regression equation:

$$q_{it} = \beta_0 + \beta_1 Red_i + \beta_2 Yellow_i + \beta_3 Green_i + [\beta_4 + \beta_R Red_i + \beta_Y Yellow_i + \beta_G Green_i] * Treat_i + \alpha_i + \delta_t + \epsilon_{it}$$

where q_{it} is the sales quantity (in dollars) for each product i by week t, Red_i is a dummy variable for products with red labels, $Yellow_i$ is a dummy variable for products with yellow labels, $Green_i$ is a dummy variable for products with green labels, $Treat_t$ is a dummy variable for treat weeks ($12 \geq t \leq 15$), α_i is the unobserved time-invariant individual effect, δ_t is the fixed effect variable, and ε_{it} is the error term.

Treatment Group: $T_{r,y,g}$(after - before)
Control Group: C(after - before)
} Difference = Effect

FIGURE 9. Difference in difference calculations measure the discrepancy between changes in the treatment and control groups. For each of the three label colors (*r,y,g*), the effect of the labels = *Delta T - Delta C.*

The resulting statistical analysis depicted which colors and categories experienced significant changes. I determined whether the implementation of eco-labels correlated with a change in purchasing choices by looking at β_4, and measured the direction and magnitude of the changes by looking at β_R, β_Y, and β_G. This system of controlled experimentation allowed me to differentiate between regular sales fluctuations (e.g. drops during Spring

Break) and fluctuations in the treatment but not the control groups—the latter being the relationship that I was interested in.

Results

Data Collection

Around 2/3 of all sales transactions at the Food Collective were with students, with roughly the same proportion for just bulk products (the treatment group). The similar trending of the lines in Figure 10 confirm that the control group was a good estimation of the treatment group, particularly for the red-labeled products.

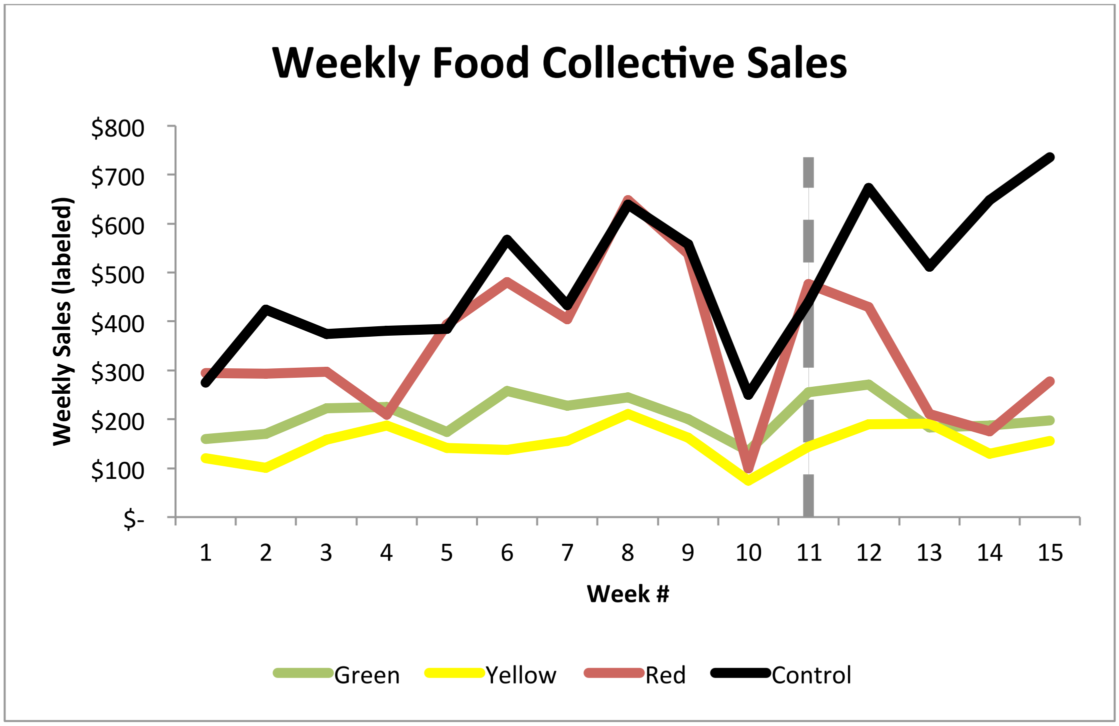

FIGURE 10. Summed sales trends of labeled (by color) and unlabeled (black) products by week for the Spring 2014 semester. The labels were implemented at the beginning of week 12.

Data Analysis

The regression analysis was run in STATA (Appendix A). All relevant results were statistically significant at the 5% level (Fig. 11). Implementing the labeling system of tri-colored eco-labels had an overall effect of decreasing estimated total sales of bulk products by 41.8%, which was the opposite direction of change from my expectation. Additionally, unlike my prediction, estimated sales of red-labeled, yellow-labeled, and green-labeled products all decreased by at least 1/3 each.

Treatment	Regression Coefficient	Effect	p-value
All labels	β_4	-41.8%	0.000
Red labels	β_R	-49.3%	0.000
Yellow labels	β_Y	-33.7%	0.038
Green labels	β_G	-38.4%	0.003

FIGURE 11. Implementing a labeling system decreased estimated total sales. Additionally, estimated sales of each individual color decreased. At the 5% confidence level, all analysis was statistically significant.

Discussion

The tri-colored eco-labels had a negative impact on store sales. The individual impact of each colored label and the general impact of labeling were all statistically significant decreases in product sales. Red-labeled products decreased the most dramatically (by 49.3%), which was consistent with my expectations that sales of products labeled as unsustainable would fare the worst. Yellow- and green-labeled products also decreased (by 33.7% and 38.4%, respectively), albeit by smaller magnitudes than the red-labeled products. The decreased sales across all label types could be attributed to many potential causes, but I suspect that the overall labeling system discouraged students from purchasing the treatment products and shifted buying habits to unlabeled grocery products. Because the Food Collective is so small and bulk products are mostly snack items, customers could readily switch between products that were in bulk bins and labeled, and those that were in other sections and unlabeled. For example, if a customer was deterred by an eco-label on the bulk trail mix, he or she could buy similar trail mix in prepackaged form from a section of the store without eco-labels. Thus, it was easy for someone shopping at the Food Collective to avoid the eco-labels, and it seems that many students did so. I believe that this kind of avoidance of eco-labels is not unique to the Food Collective; if anything, it would likely be more prevalent at a "normal" grocery store with less strict purchasing standards.

In this study, I hypothesize that the largest contributing factor in avoidance of treatment products was a skepticism of eco-label accuracy. With the current plethora of labeling systems and lack of standards or oversight, many consumers are weary of misinformation (Wozniacka 2012). Rather than commit to understanding a new labeling system and buying into its accuracy, customers might choose to purchase alternative products. This type of behavior would be even more likely to occur amongst eco-conscious shoppers—like those who shop at the Food Collective—because of the heightened awareness for sustainability information and concern for intentional purchasing behavior.

A puzzling result was that green product sales decreased by more than yellow product sales. Although not significantly different from each other (at a significance level of 0.7766), it provides interesting support for the hypothesis that consumers prefer the yellow (or "safe") products to the extremes.

These findings suggest that students purchase fewer products when those products are labeled by a tiered system of environmental impact.

Limitations

The largest limitation to this study was the inability to use livestock product containment as a measure and indicator of sustainability to consumers. The Food Collective was very accessible to me and provided a unique space for marketing manipulation, so despite its small selection of products it was largely an ideal study site. A second limitation was that some products exhibited a decrease in sales simply because the inventory ran out during the treatment phase. However, assuming this was true across all weeks, it was controlled for in the regression by α_i. A third limitation was that cashiers—oftentimes pressed for time—guessed whether or not some customer were students rather than asking, affecting the filter for student-only data. But again, if this error was time-invariant, then α_i controlled for it. The final, major limitation was the use of food miles as an indicator of sustainability. Many people, including "foodies" (food-conscious students) who shop at the Food Collective, do not believe that food miles are an accurate representation of a food product's environmental impact.

One possibility to expand this study would be to find a site system (grocery store) with larger sales volumes and a more steady inventory, and to assign treatment products such that there was no way to directly substitute a labeled product with an unlabeled product. I would also choose a different sustainability metric.

Broader Implications and Significance

Food consumption contributes significantly to GHG emissions (Garnett, 2009). Consequently, human diet types (on a large scale) have considerable environmental implications. If food energy consumption and diet preferences remain constant at 1995 levels, global agricultural non-CO_2 emissions will increase significantly until 2055; however, a reduction in meat consumption would have the potential to decrease emissions even compared to 1995 levels (Popp, Lotze-Campen, & Bodirsky, 2010). This study explored the extent to which eco-labels can affect diet shifts in college students. This study suggests that favorable diet shifts are possible if eco-labels are used effectively (e.g. labeling all unsustainable products).

This information could be useful for implementing labeling policies on foods consumed by young adults, specifically at grocery stores in college towns. If college students' diets can be shifted favorably, the habits are likely to extend through their lives (Levi, Chan, & Pence, 2010) and make the environmental impact (emissions decreases) long-term. However, the findings also warn that any type of eco-label could lower sales of a particular product.

Acknowledgements

Sofia Villas-Boas graciously acted as my advisor and her work inspired this study. Carina Galicia coordinated all the work of the honors students and promptly answered all my incessant questions. Kurt Spreyer and Petina Mendez guided me and other thesis students through the research process. Scott Kaplan, Judy Li, and Kourosh Adlparvar were three of my fellow undergraduate honors researchers who provided me with support. The Food Collective and particularly Gwen von Klan, the Operations Manager at the time of this project, were available to my needs and aided in my academic pursuits. Adam Merberg (PhD, Mathematics) and Daley Kutzman (PhD, Agricultural Resource Economics) are graduate students whose invaluable help allowed me to complete this project – Adam for IT support and Daley for STATA support.

References

Bushman, B. (1998). Effects of warning and information labels on consumption of full-fat, reduced-fat, and no-fat products. Journal of Applied Psychology, 83, 97-101.

D'Souza, C., Taghian, M., Lamb, P., & Peretiatko, R. (2006). Green decisions: demographics and consumer understanding of environmental labels. International Journal of Consumer Studies, 31, 371-376.

Edwards-Jones, G., Canals, L., Hounsome, N., Truninger, M., Koerber, G., Hounsome, B., Cross, P., York, E., Hospido, A., Plassmann, K., Harris, E., Edwards, R., Day, G., Tomos, D., Cowell, S., & Jones, D. (2008). Testing the assertion that "local food is best": the challenges of an evidence-based approach. Trends in Food Science & Technology, 19, 265-274.

Garnett, T. (2009). Livestock-related greenhouse gas emissions: impacts and options for policy makers. Environmental Science & Policy, 12, 491-503.

Hertwich, E., & Peters, G. (2009). Carbon footprint of nations: a global, trade-linked analysis. Environmental Science & Technology, 43, 6414-6420.

Levi, A., Chan, K., & Pence, D. (2010). Real men do not read labels: the effects of masculinity and involvement on college students' food decisions. Journal of American College Health, 55, 91-98.

McCluskey, J., & Loureiro, M. (2003). Consumer preferences and willingness to pay for food labeling: a discussion of empirical studies. Journal of Food Distribution Research, 34, 95-102.

McMichael, A., Powles, J., Butler, C., & Uauy, R. (2007). Food, livestock production, energy, climate change, and health. The Lancet, 370, 1253-1263.

Popp, A., Lotze-Campen, H., & Bodirsky, B. (2010). Food consumption, diet shifts and associated non-CO2 greenhouse gases from agricultural production. Global Environmental Change, 20, 451-462.

Roe, B. & Teisl, M. (2007). Genetically modified food labeling: the impacts of message and messenger on consumer perceptions of labels and products. Food Policy, 32, 49-66.

Russo, J., Staelin, R., Nolan, C., Russell, G., & Metcalf, B. (1986). Nutrition information in the supermarket. Journal of Consumer Research, 13, 48-70.

Vanclay, J., Shortiss, J., Aulsebrook, S., Gillespie, A., Howell, B., Johanni, R., Maher M., Mitchell K., Stewart, M., & Yates, J. (2010). Customer response to Carbon labeling of groceries. Journal of Consumer Policy, 34, 153-160.

Villas-Boas, B. & Hallstein, E. (2013). Can household consumers save the wild fish? Lessons from a sustainable seafood advisory. Journal of Environmental Economics and Management, 66(1), 52-71.

World Health Organization. (2004). World Health Assembly: global strategy on diet, physical activity and health. http://www.who.int/gb (accessed March 2013).

Wozniacka, G. (2012). Food labels confuse consumers as “eco-label” options multiply. *The Huffington Post*. Retrieved from http://www.huffingtonpost.com/2012/11/12/food-labels-confusing_n_2116609.html