Modeling the Nutritional Implications of Food Waste Mitigation

Food Forum Workshop Session 6

Innovations in the Food System:
Shaping the Future of Food

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Economics of Food Waste: An Overview

Measurement issues:

- Bellemare, Cakir, Peterson, Novak, and Rudi (2017) *AJAE*
- Buzby, Wells, and Hyman (2014) *USDA-ERS Bulletin* 121.

Information and Industry Initiatives:

- Wilson, Rickard, Saputo, and Ho (2017) *F. Quality & Pref.*
- Qi and Roe (2017) *Amer. J. Agricultural Econ.*

Optimal level of Food Waste and Policy Considerations:

- Lusk and Ellison (2017) *Applied Econ Letters*
- Katare, Serebrennikov, Wang, and Wetzstein (2017) *AJAE*

Broader Analysis of the Market Effects of Reduced Waste:

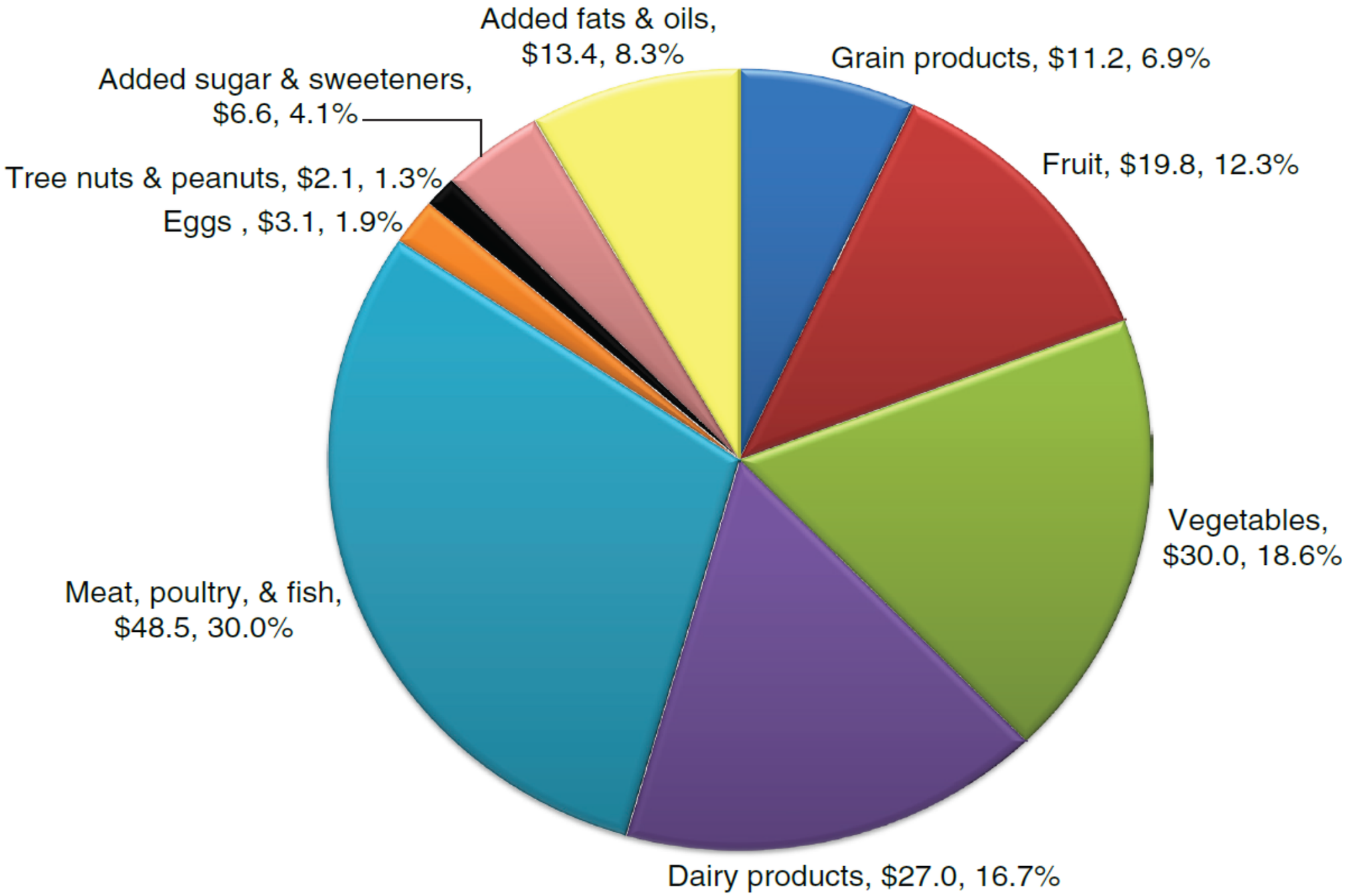
- Rutten (2013) *Agriculture and Food Security*
- Ellison, Muth, and Golan (2019) *AEPP*

Research Objective

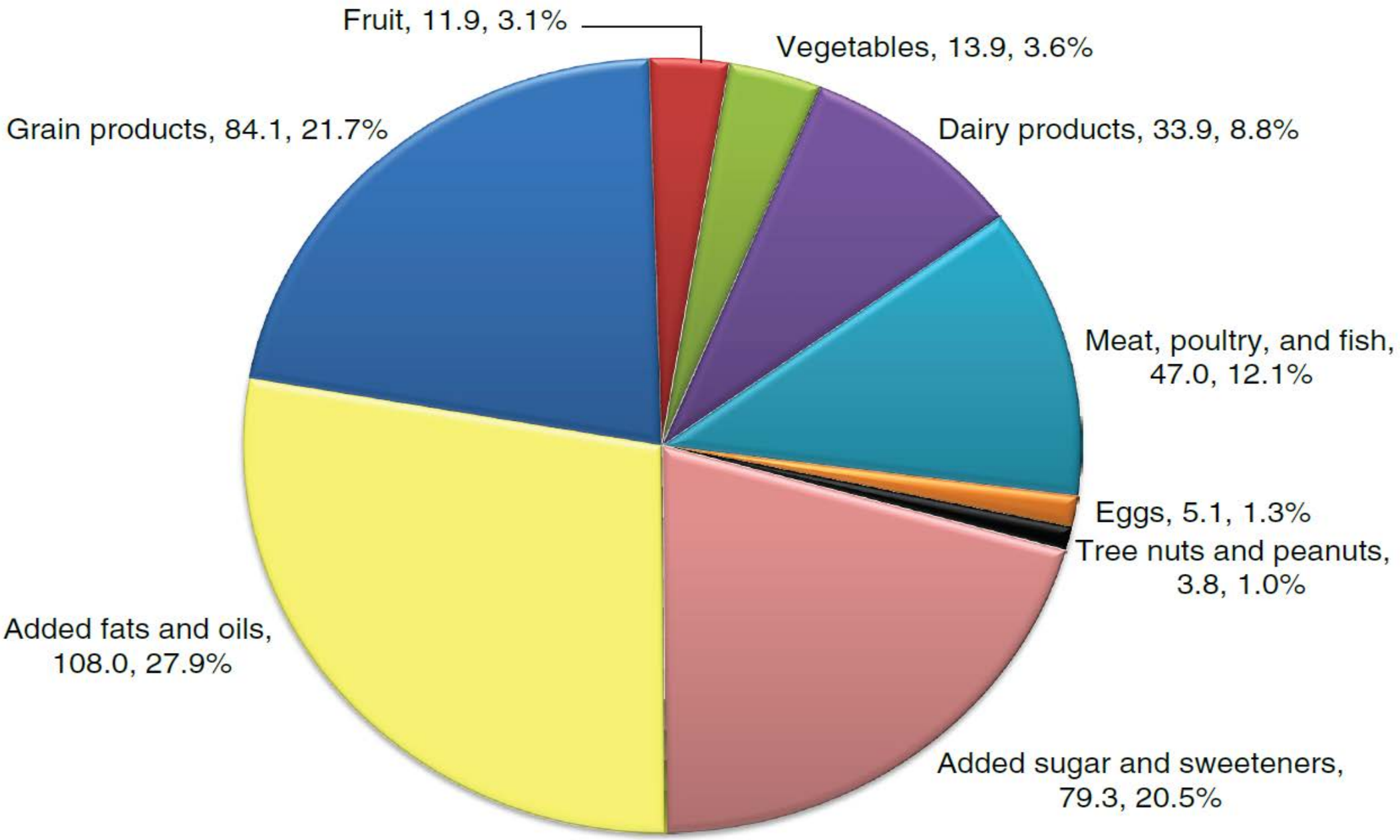
- The goal of this research is to develop a framework to consider how changes in food waste/loss (*e.g.*, via changes in date labels) will affect prices and quantities in food markets.
- Use those results to study how changes in food waste/loss would affect the overall availability of food (and nutrients) in the household.

→ We waste a lot of sugar and fats (in terms of calories); how would a reduction in food waste/loss affect our intake of sugar and fats?

Annual value ($B) of U.S. food waste



Total calories (billion kcal per day) from U.S. food waste



Our Contribution

- First, we have conducted a large-scale survey to elicit consumers' "likelihood of discarding" products one day past the due date
  - We are doing this for 15 products across all the major food groups
  - We are doing this for a variety of date labels (Use by, Best by, Sell by, Best if used by) and Smart labels that mimic those that have recently been used by retailers in the UK.
- Second, we are subsequently using the estimates from the survey work to simulate changes in retail food/nutrient purchases as a way to understand the implications in food markets

The 15 Products and the Corresponding 7 (+2) Food Groups

1. Bread
2. Cookies

→ 1. Cereal

3. Chicken
4. Ham

→ 2. Meat

5. Eggs

→ 3. Eggs

+8. Alcohol

6. Cut fruit
7. Salad greens

→ 4. F&V

+9. FAFH

8. Milk
9. Yogurt

→ 5. Dairy

10. Juice
11. Soda

→ 6. Non-alcoholic beverages

12. Butter
13. Nuts
14. Soup
15. Jam

→ 7. Other

The 10 Treatments

0. Control: Date but no text that all subjects see
1. Best by <*date*>
2. Use by
3. Sell by
4. Best if Used by

5, 6, 7. Bio-Sensor (3 indicators) + Use by

8, 9, 10. Bio-Seonsor (3 indicators) + Best if Used by

An example of the Control

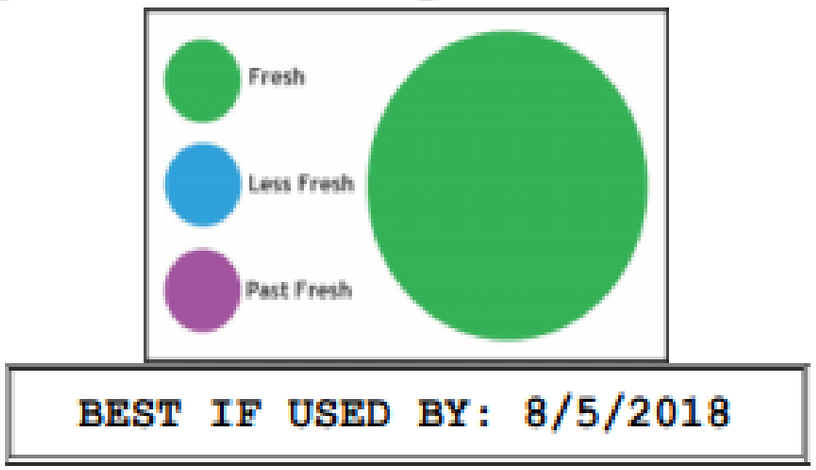
8/5/2018

32 ounces of orange juice

How likely is it that you will discard all of this product due to the label above? *Remember this product does not appear contrary to your expectations.*

Extremely unlikely	Somewhat unlikely	Neither likely nor unlikely	Somewhat likely	Extremely likely	I do not consume this product.
○	○	○	○	○	○

An example of one of the "Biosensor" Treatments



32 ounces of orange juice

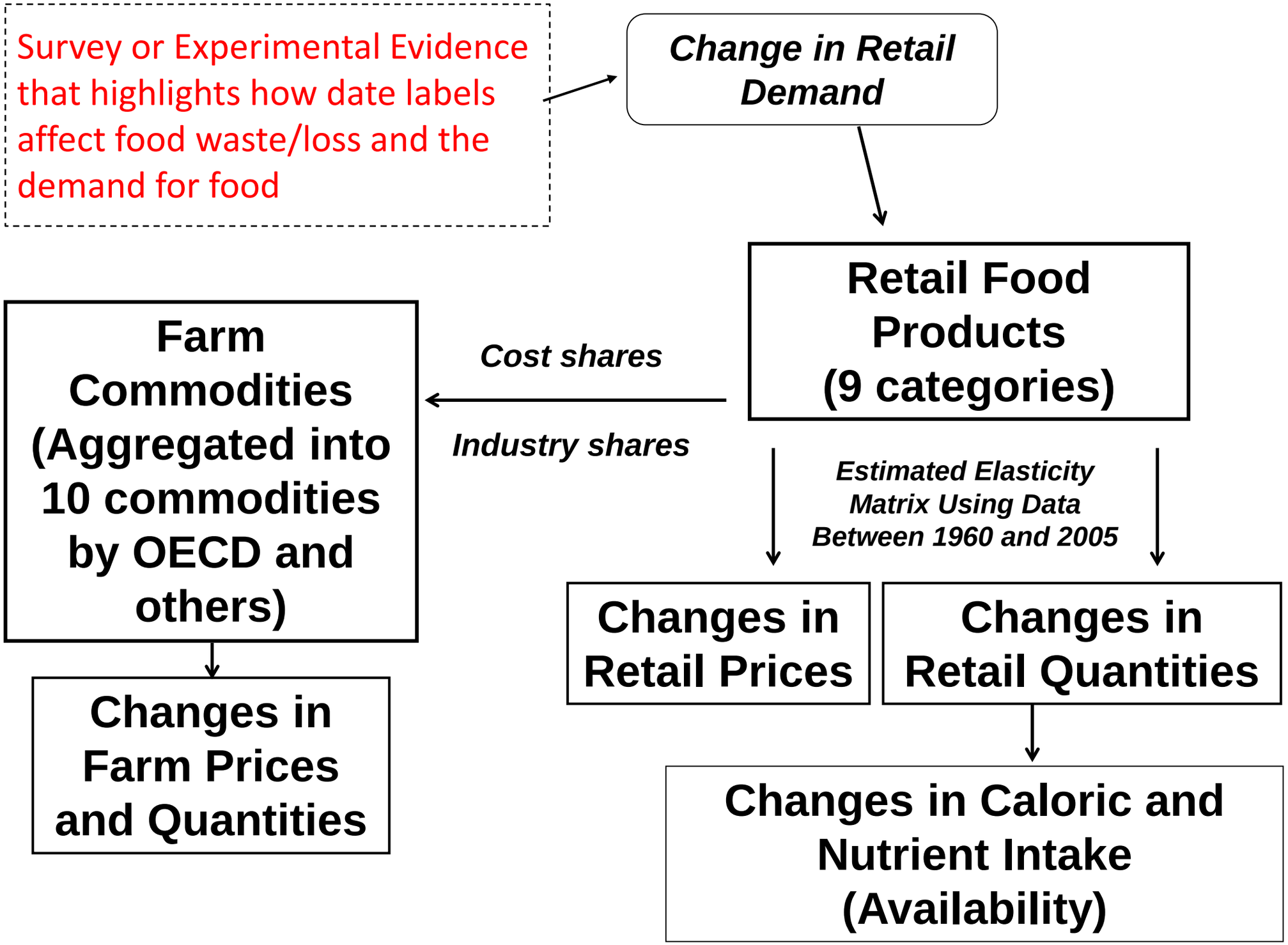
How likely is it that you will discard all of this product due to the label above? *Remember this product does not appear contrary to your expectations.*

» Extremely unlikely » Somewhat unlikely » Neither likely nor unlikely » Somewhat likely » Extremely likely » I do not consume this product.

Summary Statistics (vs Control): Average Discard Rates for Selected Treatments

Likelihood to discard	*Extremely likely*	*somewhat likely*	*neither*	*somewhat unlikely*	*extremely unlikely*
Control	0.12	0.15	0.08	0.26	0.40
Best by	0.08	0.14	0.08	0.24	0.46
Green_BIUB	0.09	0.09	0.05	0.17	0.60

AN OVERVIEW OF OUR FRAMEWORK



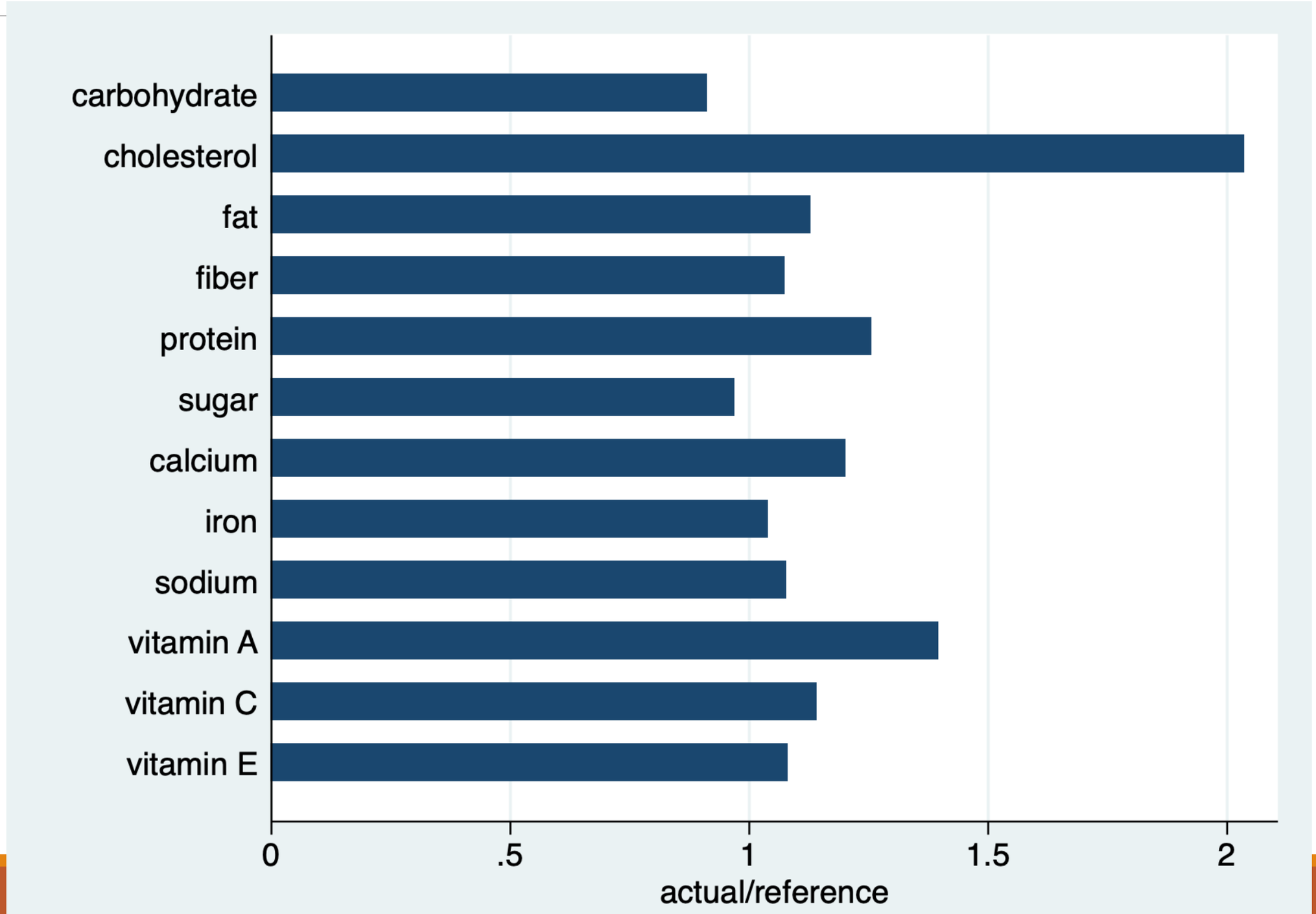
Nutrition Simulations:

Shifting to/Emphasizing the “Best by” date label

Nutrient	cereal & bakery	meat	egg	dairy	F&V	other food	beverage	FAFH	alcohol	total
calories	-1008.2	-1098.2	-387.7	-970.1	-781.6	-1103.6	-472.9	19	80.1	-5723.2
protein	-24.7	-117.3	-28.6	-49.9	-18.2	-44.9	-3.7	0.7	0.5	-286.1
carbohydrate	-176.2	-12.7	-1.9	-91.5	-146.7	-108.3	-115	2.3	4.4	-645.6
sugar	-41.9	-2	-1.3	-82.5	-64.6	-33.1	-101	1	0.5	-324.9
fiber	-11.9	-0.5	0	-1.7	-24.4	-9.3	-1	0.1	0	-48.7
fat	-24.3	-61.2	-28.6	-45.7	-19.8	-56	-1.2	0.7	0	-236.1
cholesterol	-27.6	-398.8	-820.6	-151	-13.8	-177.3	-1.1	2.5	0.1	-1587.6
vitE	-3	-2.4	-3	-1.6	-4.8	-6.8	-0.7	0.1	0	-22.2
vitA	-297.2	-123.9	-374	-756	-626.9	-298.5	-39.1	4.6	0.1	-2510.9
vitB1	-1.6	-0.8	-0.1	-0.5	-0.6	-0.8	-0.2	0	0	-4.6
vitB2	-1.2	-0.9	-1	-2.1	-0.5	-0.8	-0.8	0	0	-7.3
vitB6	-1.2	-2	-0.3	-0.5	-1.5	-0.8	-0.3	0	0.1	-6.5
vitB12	-2.6	-7.1	-1.9	-5.7	-0.3	-2	-0.3	0	0	-19.9
vitC	-9.5	-2.3	0	-7.8	-153.3	-20.7	-110.2	0.6	0.1	-303.1
vitD	-1.3	-5.3	-4.6	-11.2	-0.3	-1.4	-0.8	0	0	-24.9
calcium	-357	-104.1	-121.3	-1722.4	-233	-366.1	-244.4	7.2	7	-3134.1
magnesium	-135.3	-117.6	-26.3	-148.8	-187.9	-144.4	-90.9	2.3	9.5	-839.4
iron	-16.7	-6.8	-3.5	-1.7	-5.8	-7.3	-1.6	0.1	0.1	-43.2
sodium	-1507.6	-3201.7	-701.6	-1118.2	-1205.6	-2336.8	-196.2	32.4	7.2	-10228.1
potassium	-564	-1667.5	-311.9	-1706.3	-2601.4	-1177.7	-1141.2	22.3	52.9	-9094.8

Shifting to a “Best by” date label:

Relative availability of nutrients



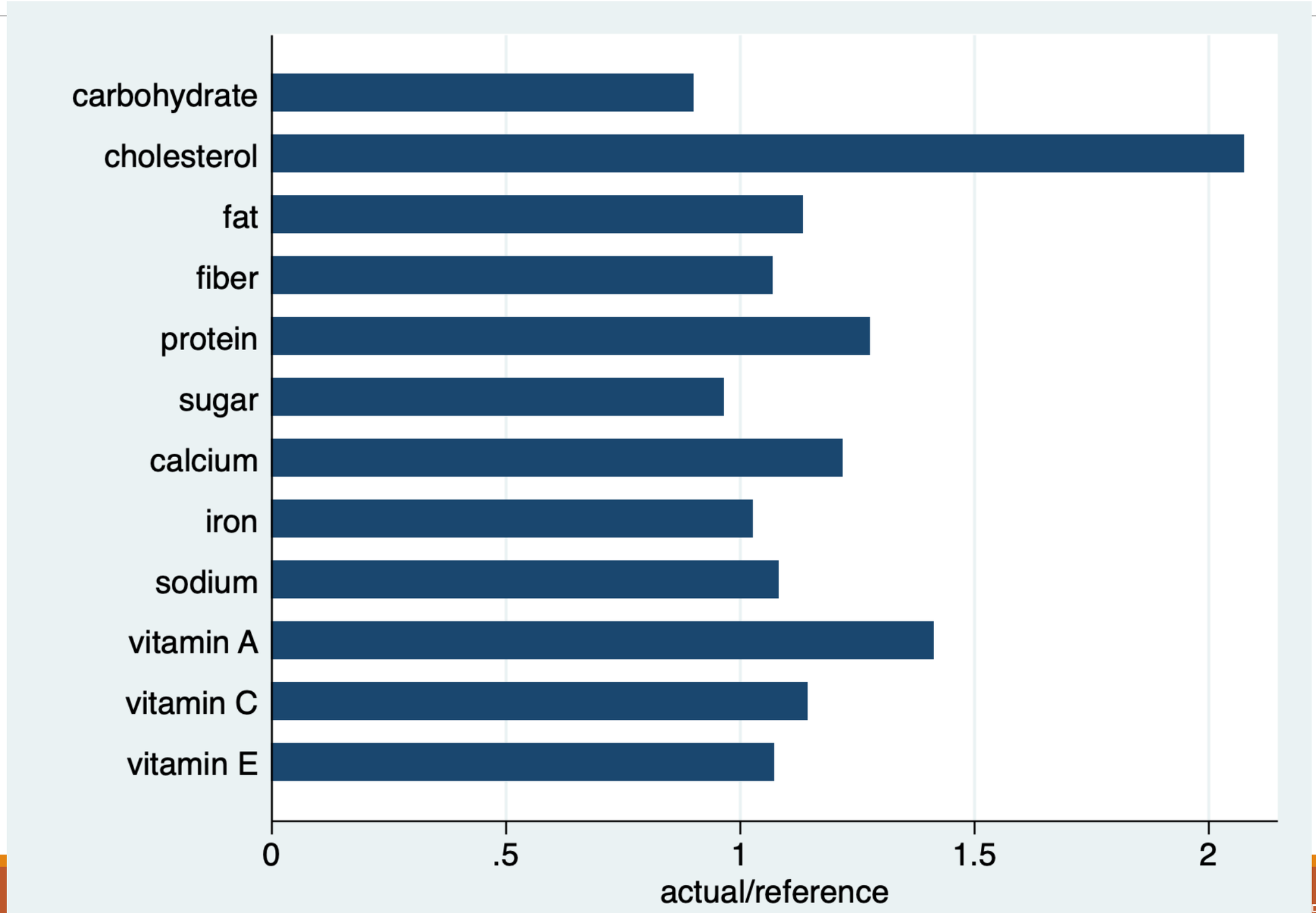
Nutrition Simulations:

Shifting to a Green Biosensor + BIUB that shows "Still Fresh" one day after the due date

Nutrient	cereal & bakery	meat	egg	dairy	F&V	other food	beverage	FAFH	alcohol	total
calories	-2190.1	-2648.1	-894.5	-2295.2	-1829.9	-2290	-1051.3	41.8	191.5	-12965.8
protein	-53.7	-282.9	-65.9	-118.1	-42.7	-93.2	-8.2	1.6	1.2	-661.9
carbohydrate	-382.8	-30.7	-4.4	-216.5	-343.5	-224.8	-255.6	5	10.4	-1442.9
sugar	-91.1	-4.9	-3.1	-195.3	-151.2	-68.7	-224.5	2.3	1.3	-735.2
fiber	-25.8	-1.1	0	-4	-57.1	-19.3	-2.2	0.3	0	-109.2
fat	-52.7	-147.6	-65.9	-108.1	-46.3	-116.2	-2.8	1.6	0	-538.0
cholesterol	-60	-961.6	-1893	-357.3	-32.3	-367.8	-2.4	5.4	0.2	-3668.8
vitE	-6.6	-5.8	-6.9	-3.7	-11.1	-14.1	-1.5	0.1	0	-49.6
vitA	-645.5	-298.6	-862.8	-1788.7	-1467.7	-619.4	-86.9	10.2	0.2	-5759.2
vitB1	-3.4	-2	-0.2	-1.1	-1.5	-1.6	-0.6	0	0	-10.4
vitB2	-2.7	-2.2	-2.4	-5	-1.2	-1.7	-1.9	0	0.1	-17.0
vitB6	-2.6	-4.8	-0.8	-1.2	-3.6	-1.7	-0.8	0	0.2	-15.3
vitB12	-5.6	-17	-4.3	-13.4	-0.8	-4.2	-0.8	0.1	0.1	-45.9
vitC	-20.7	-5.5	0	-18.4	-358.9	-43	-245	1.4	0.3	-689.8
vitD	-2.9	-12.9	-10.6	-26.4	-0.7	-2.9	-1.7	0.1	0	-58.0
calcium	-775.6	-250.9	-279.9	-4075.1	-545.5	-759.5	-543.3	15.7	16.8	-7197.3
magnesium	-293.8	-283.6	-60.6	-352.1	-439.8	-299.6	-202	5.1	22.7	-1903.7
iron	-36.2	-16.5	-8.2	-4	-13.6	-15.2	-3.6	0.3	0.3	-96.7
sodium	-3275	-7720.4	-1618.5	-2645.5	-2822.4	-4848.6	-436.2	71.3	17.3	-23278.0
potassium	-1225.1	-4020.8	-719.5	-4036.9	-6090.2	-2443.7	-2536.8	49.1	126.4	-20897.5

Shifting to a Green Biosensor + BIUB that shows "Still Fresh" one day after the due date:

Relative availability of nutrients



Research Implications

- Some date label wording (Best by and Sell by) and use of Biosensors affects the likelihood to discard food items, but it differs across food items: Meat, F&Vs, and Dairy affected most; Other foods and Cereals affected the least
- If the government/society were able to use/improve date label information to reduce food waste, and this led to less purchases, our results show that it would disproportionately decrease waste of calcium, fat, cholesterol, and protein (compared to sugar and carbohydrates)
- This would then lead to changes in the overall availability of nutrients in the household, and we would see relatively greater availability of calcium, fat, cholesterol, and protein

Thank you for your attention!

Questions or comments?

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