

# An Economic Look at the Rise in Obesity

Fall 2009

## Introduction

- Rapid increase in obesity since 1970
  - In 1970, 14% of the population was obese
  - Today, rates are 34%
- Up through 1970s, long terms trend are such that improvements in body size have been health iproving (Fogel)
- Now the average BMI is in dangerous range

Figure 1: Historical trends in BMI

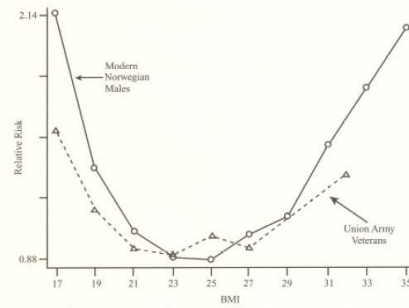
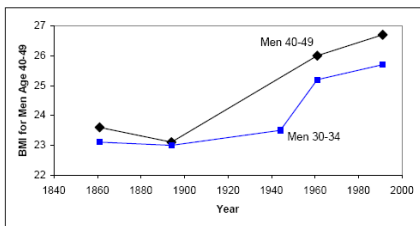
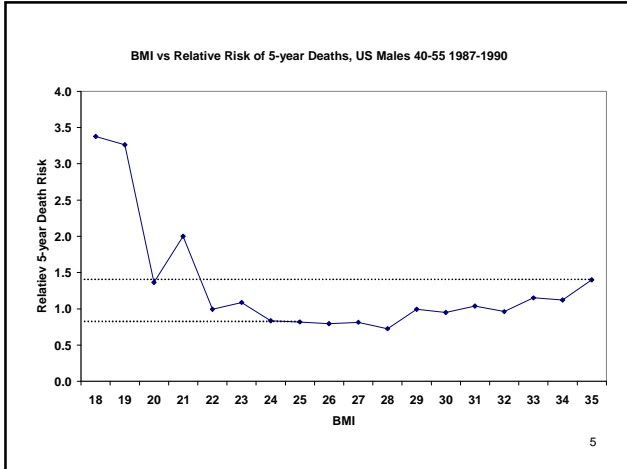


Figure 2.3 Comparison of Relative Mortality Risk by BMI among Men 50 Years of Age, Union Army Veterans around 1900 and Modern Norwegians.



### Definitions

- Obesity based on Body Mass Index
- BMI = weight (kg)/(height in cm)<sup>2</sup>
- = 703 x weight (pounds)/(height in inches)<sup>2</sup>
- BMI < 20 Underweight
- 20 ≤ BMI < 25 Ideal
- 25 ≤ BMI < 30 overweight
- 30 ≤ BMI obese

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### Two primary sources of BMI data

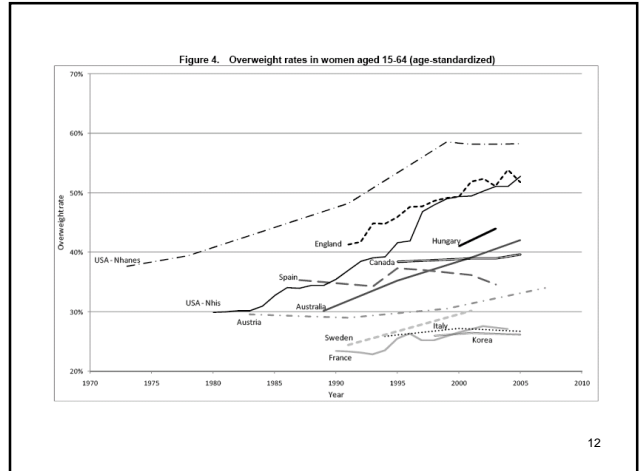
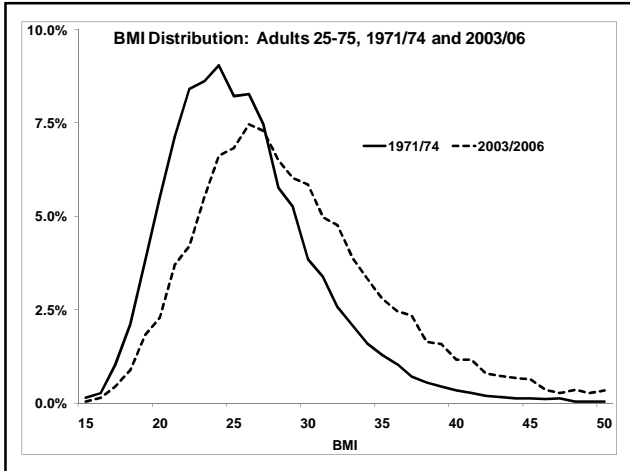
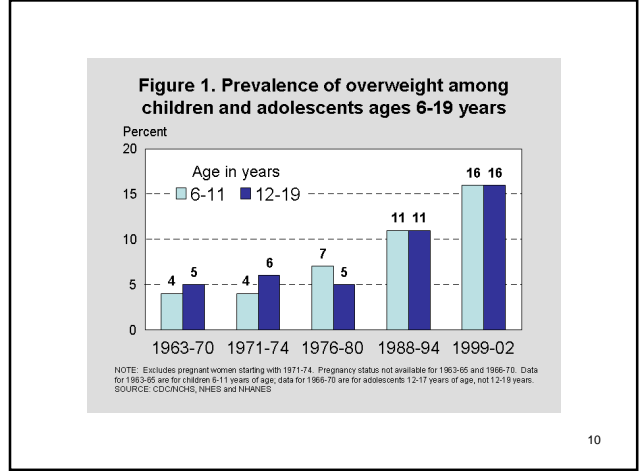
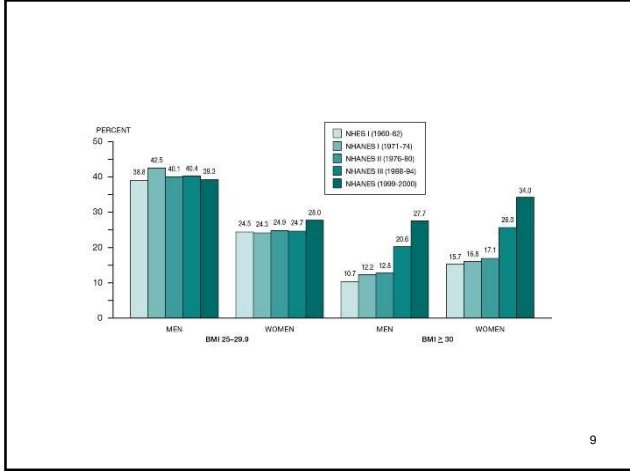
- National Health Interview Survey
  - Annual survey of 160K people
  - Self reported health conditions (including height and weight)
  - Tend to overstate height, understate weight
- National Health Examination and Nutrition
  - Frequent surveys of 6K-12K people
  - Detailed physical exams (including blood tests)

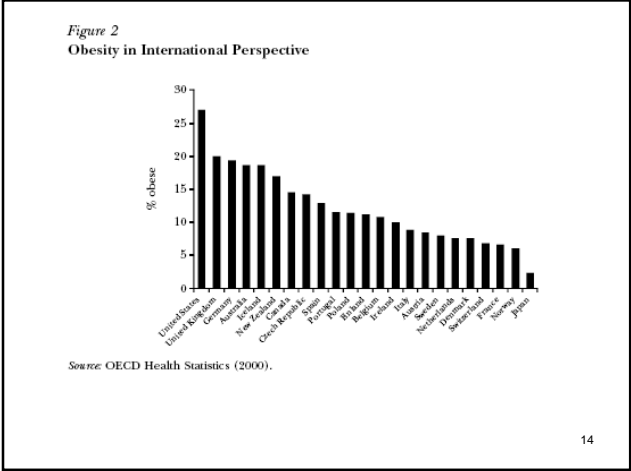
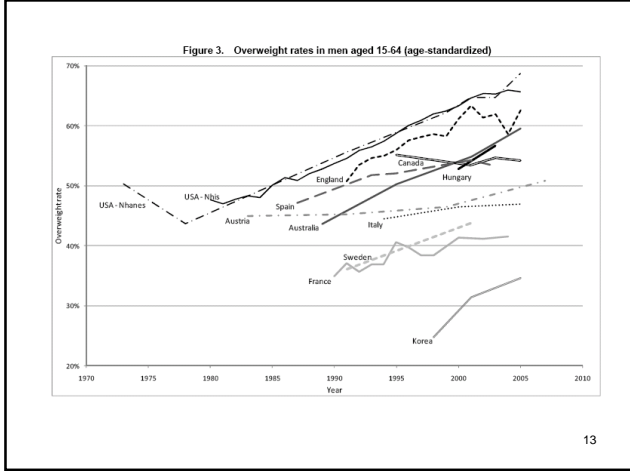
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### Obesity Rates Over Time

Group	Obesity		Overweight	
	1971/74	2003/06	1971/74	2003/06
All	15.8	34.1	50.1	69.0
Males	12.8	34.8	56.5	71.0
Females	18.6	38.0	44.4	63.4
Black F.	32.0	56.1	63.3	82.9

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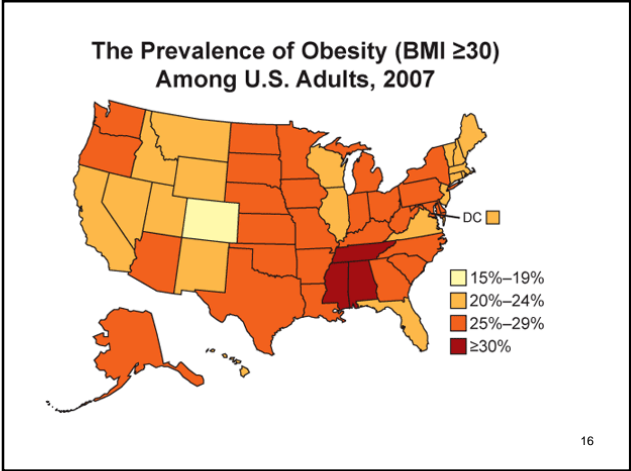




**% Obese for Different Groups**

Group	71-75	89-94	Δ(% change)
Single male	8	19	8 (138%)
Mar. male, non working spouse	13	26	13 (100%)
Mar. male, Working spouse	11	24	13 (18%)
S. female	18	32	14 (78%)
Mar. female, not working	16	36	19 (125%)
Mar. female, working	13	33	21 (175%)

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- 5 highest

- MS 32.0%
- AL 30.3%
- TN 30.1%
- LA 29.8%
- WV 29.5%

- 5 Lowest

- CO 18.7%
- CT 21.2%
- HI 21.4%
- RI 21.4%
- MT 21.8%

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## Facts to explain

- Increase is recent (started in 1970s)
  - Comes at a time when almost all other health measures are improving (blood pressure, cholesterol, smoking, pulse)
- Increase in all segments in the population
- Increase has not been as great in other developed countries

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## Usual suspects

- TV
- Lack of exercise
- Super-sized fast food meals
- Working moms
- Decline in smoking
- Built environment
  
- Can dispose of some of these right away

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- Why is this a difficult problem to disentangle?
- An increase in 100-150 calories/day would explain 10-12 pound increase in weight over past 20 years.
  - Equal to 3 Oreos
  - One can of Pepsi

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## Basics of the problem

- Cutler et al. show that the problem is a rise in calories consumed, not a fall in calories burned
- Data from a variety of sources
  - Food diaries
  - Time diaries
  - Physiological studies, calories burned by an activity

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Table 2  
Changes in Food Consumption, 1977–1978 to 1994–1996

Meal	Calories <sup>a</sup>			Change	Percentage of Total Change
	1977–1978	1994–1996			
Male					
TOTAL	2080	2347	268	100%	
Breakfast	384	+20	36	13	
Lunch	517	567	50	19	
Dinner	918	850	-50	-23	
Snacks	201	901	241	90	
Calories per meal	5.73	5.66	-.7		
Meals per day	3.92	4.53	.61		
Female					
TOTAL	1515	1658	143	100%	
Breakfast	286	312	26	18	
Lunch	368	398	31	22	
Dinner	676	602	-74	-52	
Snacks	186	546	160	112	
Calories per meal	4.22	5.08	+.86		
Meals per day	3.86	4.44	.58		

## Note

- Meals have increased
- Calories per meal has stayed the same
- Big increase in snacks and calories from snacks
- How does these results eliminate the hypothesis that “Super sized” meals are the cause of the problem?

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Table 3  
Time Use, 1965–1995  
(Minutes per day, age 18–64)

Activity	1965	1975	1985	1995
Paid work	900	958	950	956
Eating on the job	11	8	8	—
Breaks	8	4	5	—
Household work	146	128	124	132
Food preparation	44	41	39	27
Meal cleanup	21	12	10	4
Child care	37	31	31	18
Obtaining goods and services	51	45	55	49
Personal needs and care	622	644	654	632
Meals at home	58	54	50	55
Meals out	11	19	19	(meals at home & out)
Sleeping/napping	478	496	479	495
Education and training	12	16	18	23
Organizational activities	20	24	18	17
Entertainment/social	78	65	65	72
Recreation	27	37	43	47
Active sports	5	4	10	13
Outdoor	1	7	5	6
Walking/hiking/exercise	1	2	4	5
Communication	158	191	195	212
—	—	—	—	—
TOTAL	1440	1440	1440	1440
Cal per minute per kilogram	1.69	1.57	1.62	1.53
E for 70 kilogram man	16.4	15.5	14.7	12.6
E for 60 kilogram woman	15.1	12.3	15.5	11.3

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### Time use in minutes/day

	1965	1975	1985	1995
Paid wk	290	258	259	266
House wk	146	128	124	102
food prep	44	41	39	27
WatchTV	89	129	129	151
Exercise	27	37	43	47

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### Energy

- Big drop in housework
- Slight drop in work
- Increase in exercise
- Increase in sedentary activity (TV)
- Convert into energy index

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### Energy used (Kcal per day)

	1965	1975	1985	1995
Males	16.4	13.5	14.7	12.6
Females	15.1	12.3	13.5	11.3

I am pretty sure the text in the Cutler et al. paper is in error about the units of Measure on this variable. The key is that since 1975, the measure of energy Has not fallen sharply. Since 1975m, calories burned have fallen by  $(11.3-12.3)/12.3 = -0.081$  for females and  $(12.6-13.5)/13.5 = -0.067$

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### Cutler et al. theory Technological change in food production

- Major advances in food preparation such vacuum packing, microwaves, freezing, preservatives, etc.
- Technology has reduced the time and direct cost of food preparation
- Evidence: time spent on food preparation among non-working mothers has fallen 50% in past 25 years
- Greatly reduced the costs of certain types of higher calorie food

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## Example – French fry

- Americans have always consumed lots of potatoes
- Until recently (post WWII), French fry consumption was limited
- High cost of preparation (peeling, cutting, frying)
- Innovations
  - allowed the fry to be cut, peeled fried and frozen at central relocation
  - Reheated in oil or in oven
- From 1977-1995, potato use increased by 30% -  
- all of it an increase in fries and chips

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## Implications

- Greater variety of foods. Therefore, more meals and less food per meal.
- Evidence
  - Increase in snack food
  - Increase in meals
  - Fall in the price of prepared food

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## Relative Price Changes for Certain Foods, 1/1980 – 11/2003

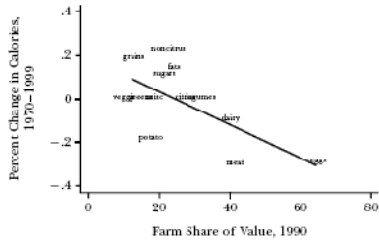
- |                       |      |
|-----------------------|------|
| • All consumer prices | 137% |
| • Fresh fruit         | 276% |
| • Fresh vegetables    | 252% |
| • Dairy products      | 96%  |
| • Frozen food         | 83%  |
| • Frozen potatoes     | 93%  |
| • Potato chips        | 77%  |
| • Ground beef         | 90%  |
| • Soda                | 53%  |

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## Implications

- Increase in food consumption should be greatest in foods with greater processing
- Evidence
  - Look at change in calories based on farm share of cost. Smaller farm share, less processing. We see the biggest increase in calories in those sectors with small farm share
  - Look at change in calories based on brand names. Brand names have more processing<sup>32</sup>

Figure 3  
Food Preparation and Changes in Intake



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## Implications

- Individuals that take advantage of technology should have biggest increase in obesity
- Evidence
  - Increase in single males compared to non-working married females
  - Some contrary evidence, big increase for highest educated

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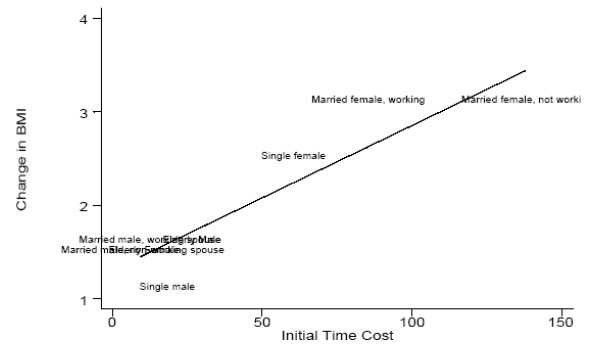
Table 4  
Time Costs by Demographic Group  
(minutes)

	1965		1995	
	Meal Prep.	Meal Prep. + Cleanup	Meal Prep.	Meal Prep. + Cleanup
Adults				
Single male	13.6	18.1	15.5	17.3
Married male, nonworking spouse	6.5	9.4	13.2	14.4
Married male, working spouse	8.1	11.9	13.2	14.4
Single female	38.1	60.1	28.9	33.1
Married female, working	38.3	84.8	35.7	41.4
Married female, not working	94.2	137.7	37.7	68.8
Elderly				
Male	16.6	26.3	18.5	20.2
Female	65.9	10.4	50.1	60.3

Source: Authors' calculations from Americans' Use of Time Survey Archives, 1965 and 1995.

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Figure 9: Time Costs and Changes in BMI Using Sex-Specific Time



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## Can snack taxes solve obesity problem?

- Success of cigarette tax has encouraged some to look to taxes to solve the obesity problem
- At least 40 states have some form of sales tax on soda
- 55% of adults surveyed favored a junk food tax to pay for health care reform
- 1 cent/can raises \$1.5 billion

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## Some examples

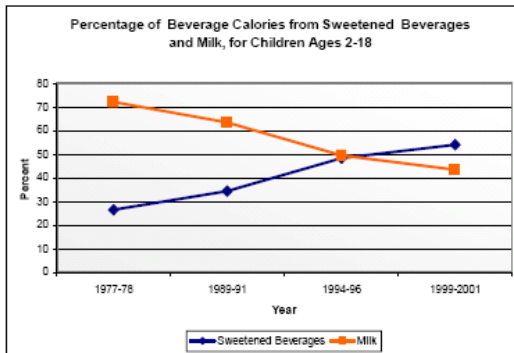
- IN has 6% sales tax on soda (vending machine/stores), chips/pretzles (vending)
- DC 5.75% sales tax on snack food and soft drinks purchases via vending machines
- MD and LA repealed junk food taxes in 1990s for Frito Lay plants
- ME had 5.5% sales tax on snacks/soda – repealed after 10 years – during that time, obesity rates doubled<sup>38</sup>

- Most recent: proposal in NY for 18% junk food tax

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- Plus
  - Demand curves slope down
  - Good experience w/ alcohol/cigs
- Minus
  - Snacks are small component of consumption
  - benefits on BMI may take years to be realized
    - Not like alcohol/cigarettes where benefits are realized right away

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## Empirical question

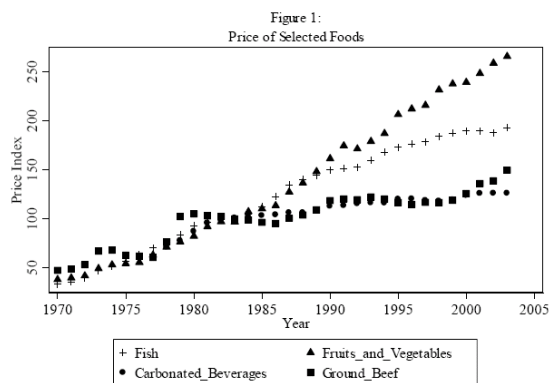
- What will price changes do to the demand for snacks?
- As people substitute away from snacks, what will they drift towards
  - Will calories decline or will they shift?
- Two papers examine this
  - Gelbach et al.
  - Goldman et al.

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## Gelbach et al.

- Use data from the 1982-1996 NHIS
- Measure self-reports to height/weight to construct BMI (obese and over weight)
- Construct price index of health versus unhealthy foods
- Does obese/overweight vary when this relative price index is altered?

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### Unhealthful Foods

American processed cheese, per lb. (453.6 gm)  
 Bologna, all beef or mixed, per lb. (453.6 gm)  
 Butter, salted, grade AA, stick, per lb. (453.6 gm)  
 Cola, nondiet, cans, 72 oz. 6 pk., per 16 oz. (473.2 ml)  
 Cupcakes, chocolate (cost per pound/453.6 grams)  
 Ice cream, prepackaged, bulk, regular, per ½ gal.  
 Malt beverages, all types, all sizes, per 16 oz.

Margarine, stick, per lb. (453.6 gm)  
 Peanut butter, creamy, all sizes, per lb. (453.6 gm)  
 Pork and beans, canned (cost per 16 ounces)  
 Potato chips, per 16 oz.  
 Potatoes, frozen, French fried, per lb. (453.6 gm)  
 Shortening, vegetable oil blends, per lb. (453.6 gm)

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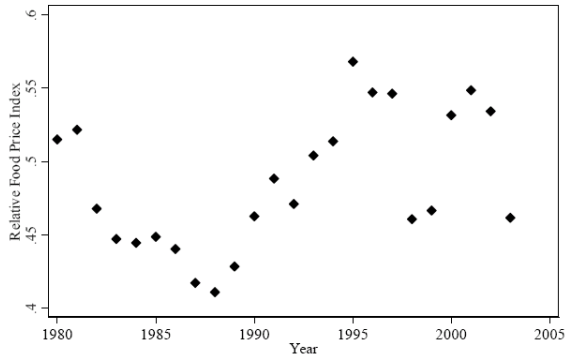
### Healthful Foods

Apples, Red Delicious, per lb. (453.6 gm)  
 Bananas, per lb. (453.6 gm)  
 Beans, dried, any type, all sizes, per lb. (453.6 gm)  
 Beans, green, snap (cost per pound/453.6 grams)

Broccoli, per lb. (453.6 gm)  
 Cabbage, per lb. (453.6 gm)  
 Carrots, short trimmed and topped, per lb. (453.6 gm)  
 Celery, per lb. (453.6 gm)  
 Cherries, per lb. (453.6 gm)  
 Corn on the cob, per lb. (453.6 gm)  
 Crackers, soda, salted, per lb. (453.6 gm)  
 Cucumbers, per lb. (453.6 gm)  
 Grapefruit, per lb. (453.6 gm)

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Figure 2:  
 Price Healthful/Price Unhealthful



## Key points

- Regional variation in price indexes
- Authors exploit variation over time and across regions in price index
- Difference-in-difference type model
  - Use variation over time in a region and correlate with changes in obesity

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Table 3  
 Effect of Relative Price of Healthful Foods on BMI, Overweight, and Obesity  
 Pooled Sample  
 (standard errors clustered by region in parentheses)  
 [upper-tailed p-values generated by wild cluster bootstrap in brackets]

	OLS
BMI	0.764 (0.277) [p = 0.029]
Overweight	0.087 (0.024) [p = 0.020]
Obese	0.039 (0.022)

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## Understanding estimates

- Between 82 and 96, health/unhealthy index increased from 0.473 to 0.544, an increase of 0.071
- Coef on index in BMI model is 0.764  
 $d\text{BMI}/d\text{Index} = 0.764$
- $d\text{BMI} = d(\text{Index})(0.764) = 0.071(0.764) = 0.054$

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- Change in average BMI during entire sample is from 24.5 to 26
- Change in can explain only  $0.054/1.5 = 0.036$  or 3.6% of change over time

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## Goldman et al.

- Price changes have a dynamic component
  - Food prices impact weight
  - Weight impacts rate of growth of body
  - Changes today will alter outcomes in future as well

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## HRS

- Longitudinal survey of people aged 50 and older
  - Started in 1991
  - People born 1931-1941
  - Roughly 12K people
- Follow every two years
- Match to data on food prices for 200 US cities from US Chamber of Commerce

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- Price index – hold fixed basket of good constant, compare prices over time
- 10% increase in vegetable prices will have a different effect than a 10% increase in butter
- Generate price index based on calorie density of food
- “Price per calorie” – puts more emphasis on calorie dense food

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$$W_{igt} = \beta_0 + \sum_{k=0}^{t-1} \gamma_k W_{ig,t-k} + P_{gt} \beta_1 + Z_{gt} \beta_2 + X_{igt} \beta_3 + \alpha_i + \tau_t + \varepsilon_{igt}$$

- Data varies by individual (i), geographic region (g) and time
- W is BMI
- Regress BMI on lags of BMI plus price index and other variables

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Table 3. Effect of price per calorie on BMI

Independent variable	Model Specification		
	I	II	III
BMI two years ago	0.672*** (0.031)	0.654*** (0.036)	0.657*** (0.031)
BMI four years ago	0.210*** (0.026)	0.192*** (0.027)	0.205*** (0.024)
Log of price per calorie	-2.239** (1.027)	-1.472 (1.024)	-1.207 (1.161)

$d\text{BMI}/d\ln(\text{Price}) = -2.239$

$d\text{BMI} = d\ln(\text{Price}) * (-2.239)$

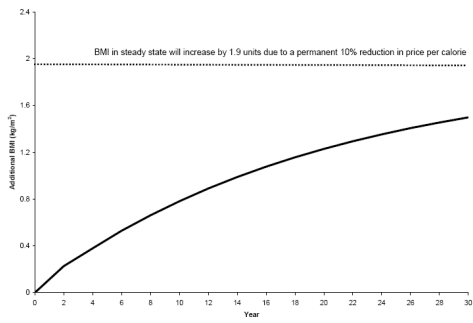
$d\ln(\text{price}) = 0.10$  (10% increase)

$d\text{BMI} = -0.22$

Average BMI is 28.7  
So a 0.22 drop in BMI from a 10% increase in price is small  
 $(0.22/28.7) = 0.008$

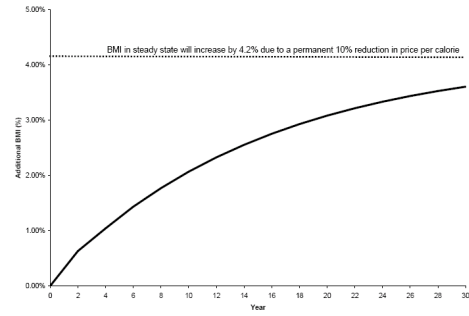
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Figure 2. Additional BMI due to a permanent 10% reduction in price per calorie



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Figure 3. Additional BMI as a percentage of total BMI due to a permanent 10% reduction in price per calorie



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- Between 1980 and 2000, BMI increased by 2.7 units
- A 10% increase in price will reduce BMI by 1.2 units over 20 years
- Wipe out 45% of the growth in BMI over past 20 years with a 10% increase in price – would require 20 years

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