"Welfare-Enhancing Technological Change and the Growth of Obesity"

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APPENDIX

A. Nutritional Data

We use Wave III of the National Health and Nutrition Examination Survey (NHANES), which was fielded from 1988 to 1994. The NHANES contains data on health, nutrition, socioeconomic, and demographic characteristics. The data consist of both self-reported information on health, and information obtained by medical care providers from physical examination and laboratory analysis of blood and urine samples. Of the 33,994 total NHANES participants, 29,314 have available data on blood samples. We use information from the blood samples to assess the existence of specific micro-nutrient deficiencies. Standard medicine and pediatrics textbooks (cf, Bhattacharya and Currie, 2001; Braunwald et al., 2001) define serum normal values for these conditions, below which patients are seen as deficient.

We focus in particular on four measures of nutritional status with clear and well-established links to diet: Vitamin A deficiency; Vitamin C deficiency; insufficient serum folate; and anemia.

Vitamin A Deficiency is defined as having serum Vitamin A levels that fall below 1.05 umol/L. People with Vitamin A deficits can suffer problems with their vision, such as night blindness or ocular deterioration. Fruit and milk (which, in the US, is fortified with Vitamin A) represent its most important nutritional sources.

Vitamin C Deficiency is defined as having serum Vitamin C levels below 11.4 mmol/L. Inadequate Vitamin C can lead to hemorrhaging of the skin or joints, anemia, or in

extreme cases scurvy. Fruit and fruit juice (particularly citrus) represent the most important sources of this nutrient.

Folate Deficiency is defined as serum folate below 7 nmol/L. Folate deficiencies in women of childbearing age can lead to birth defects. It can also lead to megaloblastic anemia, or the production of abnormally large blood cells with impaired oxygen-carrying capacity. Folate deficiencies are relatively rare in children, but fairly prevalent in adults. Orange juice and bread, which are often fortified with folate, represent important sources of this nutrient in the US.

Anemia is defined differently by age. For children under age 12, anemia is characterized by a hemoglobin count below 11.5 g/dL and hematocrit levels below 35%. For people over age 12, it involves a hemoglobin count below 12 g/dL and hematocrit levels below 37%. Anemia causes fatigue, fainting, cognitive deficits, and shortness of breath. Meat intake is the most important way to avoid anemia.

B. Price Data

To evaluate the impact of nutrition on health, we use data containing local prices for a variety of different foods. The American Chamber of Commerce Researchers' Association (ACCRA) collects quarterly data on the pre-tax retail prices of goods in various metropolitan and rural localities in the US. Since the NHANES was collected over a long period of time, the survey provides some guidance about the year in which each observation was collected, particularly whether it was collected during the first phase—from 1988 to 1991—or the second phase—from 1991 to 1994.

To link the NHANES data to the ACCRA data, we reconcile their year and geography identifiers. We have ACCRA data from 1989 to the present. In keeping with the timing

of the NHANES, we use data from 1989 to 1990, which we link to phase one observations, and data from 1992 to 1994, which we link to phase two observations. Geographically, the NHANES reports county of residence for all respondents who live in a metropolitan statistical area with 500,000 or more people. The ACCRA data are collected at the town or city-level, below the county level. However, it can be aggregated to the county level.[1] The county-level ACCRA data is then linked to the NHANES. Because NHANES reports county identifiers for only the most populous areas, about half of the NHANES sample is not geographically identified. However, at the end of our linking process, we can identify about 10,000 NHANES respondents in 22 distinct counties; these span the following states: Arizona, California, Florida, Illinois, Massachusetts, Michigan, Missouri, New York, Ohio, Pennsylvania, Rhode Island, Texas, and Washington.

The ACCRA collects data on 24 food items purchased for consumption at home. It also collects data on restaurant food, but we do not include these, as we wish to focus on the price of food itself, without conflating the price of labor and other non-food restaurant inputs. These 24 items are designed to be representative of the food expenditures by a consumer with a "middle-management" lifestyle; ACCRA supplies the expenditure weights (derived from the Consumer Expenditure Survey) associated with each good. Using these weights to aggregate the prices of all 24 goods, we can construct the price of

[1] The ACCRA collects quarterly data, and there are a few instances where it collects data on more than one area within a single county. For both these reasons, we have more than one ACCRA observation per county-year. We compute simple averages within county-year cell to aggregate the data up to this level.

a composite “food at home” good, which corresponds to a Laspeyres price index for food at home.

In our analysis of nutrient deficits, we focus on the relative prices of specific foods; this is defined as the log difference between the price of the food in question and the price of the composite food good. It is the price of the good relative to all other food items. The relative prices we use are summarized in Table 1. On average, the cheapest good is bread, while the most expensive are a pound of ground beef and frozen concentrated orange juice. In addition to being the lowest, the price of bread is also the least variable; the interquartile range covers about ten percentage points, compared with 23 percentage points for frozen concentrated orange juice.

C. Expanded Results

Table 2 presents expanded results of our analysis. The table displays the results from 19 regressions, for various age groups and nutrient deficiencies: the dashed horizontal and vertical lines in the table separate one regression from another. For each regression, we report the coefficients and standard errors on the relative food price variables, the mean of the nutrient deficiency dependent variable over the regression sample, and the regression observations. For example, the regression at the top right investigates the effect of peach and milk prices on vitamin A deficiencies for the entire population. The one at the bottom right explores these relationships for adults over the age of 18. Coefficients significant at the 10% level are shown in bold. Missing cells appear because the NHANES did not report blood test data on Vitamin C deficiencies for any child under the age of 5.

References

Bhattacharya, J., and J. Currie (2001). "Youths at Nutritional Risk: Malnourished or Misnourished?" *Risky Behavior Among Youths*. J. Gruber, ed**.** Chicago: University of Chicago Press.

Braunwald, E., et al. (2001). *Harrison's Principles of Internal Medicine*. New York: McGraw-Hill Professional Publishing.

Table 1: Summary of ACCRA Price Data, by County

	Mean	Std Dev	25th Pctile	75th Pctile
Canned Peaches	-0.32	0.11	-0.37	-0.24
Half Gallon of Milk	-0.25	0.11	-0.32	-0.16
Frozen Orange Juice	-0.14	0.13	-0.27	-0.04
Loaf of White Bread	-0.77	0.11	-0.79	-0.70
Ground Beef -- 1 lb.	-0.14	0.09	-0.18	-0.07

Notes: Log relative price is the log difference between the price of the relevant good and the composite food price.

Table 2: Expanded Results

	Low Vitamin A		Low Vitamin C		Low Folate		Anemia
	Peaches	Milk	Peaches	OJ	OJ	Bread	Grd Beef
All							
Coeff	0.035	0.056	**0.181 ****	**0.064 ***	**0.138 ****	0.195	**0.106 ****
Std Error	0.036	0.046	0.050	0.036	0.055	0.122	0.051
Mean Dep Var	(0.07)		(0.12)		(0.16)		(0.10)
Obs	6795		6059		6938		7753
Age 0-4							
Coeff	-0.027	-0.057			-0.028	0.017	**0.560 ****
Std Error	0.269	0.314	X		0.024	0.016	0.163
Mean Dep Var	(0.37)				(0.005)		(0.20)
Obs	290		0		323		1141
Age 5-9							
Coeff	**0.328 ****	0.078	-0.038	-0.003	0.018	0.012	0.088
Std Error	0.119	0.237	0.051	0.049	0.023	0.017	0.068
Mean Dep Var	(0.29)		(0.02)		(0.01)		(0.06)
Obs	837		549		881		881
Age 10-17							
Coeff	**0.191 ****	0.052	0.056	0.013	**0.123 ***	0.081	-0.084
Std Error	0.067	0.092	0.051	0.040	0.071	0.087	0.090
Mean Dep Var	(0.08)		(0.04)		(0.12)		(0.06)
Obs	926		903		944		944
Age 18+							
Coeff	-0.013	**0.075 ****	**0.212 ****	**0.078 ***	**0.196 ****	0.258	0.063
Std Error	0.017	0.024	0.063	0.044 *	0.072	0.165	0.048
Mean Dep Var	(0.03)		(0.15)		(0.20)		(0.09)
Obs	4742		4607		4790		4787

Notes: Low Vitamin A -- Serum Vitamin A < 1.05 umol/L. Low Vitamin C -- Serum Vitamin C < 11.4 mmol/L. Low Folate -- Serum Folate < 7 nmol/L. For children under the age of 12, anemia is hemoglobin < 11.5 g/dL and Hematocrit < 35%. For those over age 12, it is hemoglobin < 12 g/dL and Hematocrit < 37%. Prices are reported by county. There are 22 unique counties; standard errors are clustered by county.