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Abstract

A growing body of research supports the "economic insecurity" theory of obesity, which posits that uncertainty with respect to one's material well-being may be an important root cause of the modern obesity epidemic. This literature has been limited in the past by a lack of reliable measures of economic insecurity. In this paper we use the newly developed Economic Security Index to explain changes in U.S. adult obesity rates as measured by the National Health and Nutrition Examination Surveys (NHANES) from 1988–2012, a period capturing much of the recent rapid rise in obesity. We find a robust positive and statistically significant relationship between obesity and economic insecurity that holds for nearly every age, gender, and race/ethnicity group in our data, both in cross-section and over time.

Keywords: obesity, body mass index, economic insecurity

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1. Introduction

Obesity rates have risen dramatically in the U.S. since the 1980s, but not all demographic groups have been equally affected (Wang and Beydoun, 2007). While most obesity research has focused on dietary quality or the implicit price of a calorie (World Health Organization, 1998; Cutler et al., 2003; Chou et al., 2004), a growing body of evidence suggests *economic insecurity* (defined, roughly speaking, as the extent to which an individual's financial well-being is at risk) may be an important causal factor. The theory–inspired by theory and evidence from behavioral ecology–posits that economic insecurity triggers a physiological fattening response, in which at-risk individuals gain weight in a biological attempt to "prepare for the famine" (Smith, 2009; Smith et al., 2009; Offer et al., 2010; Wisman and Capehart, 2010; Smith, 2012b).

One longstanding barrier to estimating the effect of economic insecurity on obesity has been the inherent difficulty involved with measuring economic insecurity. Defined as "uncertainty of future income," measuring insecurity necessarily requires estimation of a probability distribution, a data intensive task. Researchers interested in this question have thus resorted to aggregate (e.g, country-level) data (Offer et al., 2010; Smith, 2012a; de Vogli et al., 2013), for which aggregate indicators of economic insecurity are available, or to individual-level panel data from which income or employment volatility over time can be measured (Smith et al., 2009; Barnes et al., 2013). These studies provide support for the economic insecurity hypothesis, but each has weaknesses: country-level panels, for instance, necessarily entail exceedingly

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small samples and a limited number of co-variates; while individual-level panels also generally have limited sample size, a problem that is exacerbated when the longitudinal nature of the data is used to estimate insecurity.

In this paper we make use of new data, in the form of the *Economic Security Index* (ESI) recently developed by Hacker et al. (2012). The ESI provides a consistent measure of economic insecurity (specifically, the probability of a 25% year-to-year household income decline) for the U.S. population by race/ethnicity, age, gender, household income, family structure, and geographic location. At the time of this writing, annual ESI estimates are available back to 1986, covering much of the period over which the obesity epidemic has occurred.

A second barrier to the study of the relationship between obesity and economic insecurity is the problem of endogeneity common to population-based studies of obesity. Because many determinants of body mass index (diet, exercise, career, etc.) are influenced by individual choices and that body mass itself might, in turn, influence or constrain those choices, it is always possible that an association between obesity and one or more putative causes (including economic insecurity status) is caused by either unobserved heterogeneity (i.e., a third factor causing both variables to co-vary) or by reverse causation. Because we are interested in identifying the causal relationship (if any) running from economic insecurity to obesity, in this paper we have chosen to exploit variation in the ESI along just four dimensions: time, age, gender, and race/ethnicity. Although, as noted above, the ESI can in practice be associated with other characteristics, we limit our analysis to characteristics that can most safely be considered exogenous to the economic environment. Thus if we find that obesity status tracks economic

insecurity along these dimensions, it cannot be argued, for instance, that obese people have selected themselves into high-ESI categories.

2. Empirical Model

This paper asks a simple question: To what extent can changes in the ESI explain changes in obesity rates in the U.S. since the 1980s? We estimate the following model:

$$BMI_{ij} = ESI_j\alpha + X_{ij}\beta + \sigma_{ij} \tag{1}$$

where BMI_{ij} is individual i's obesity status (body mass index$\geq$ 30), ESI_j is individual i's economic security index, as determined by year and exogenous demographic characteristics, X_{ij} is a vector of i's personal and group-level characteristics, and σ_{ij} is a disturbance term.

The economic insecurity hypothesis predicts $\alpha > 0$. Because we use a linear probability model in most specificaitons, our estimates of α can be interpreted as the marginal effect of an increase in the probability of experiencing a 25% income drop (i.e., an increase in an individual's ESI) on the probability of being obese.

It is important to note that ESI is distinct from the group-level unemployment rate, which does not measure year-to-year transitions or threats to household income other than job loss. Moreover, since the most commonly used unemployment statistics exclude discouraged workers, they are likely to understate the severity of prolonged downturns in the economy. Indeed, previous research on the effect of unemployment on obesity has generally shown a *negative* relationship, with people losing weight, other

things equal, during recessions (Ruhm, 2000, 2005) or when currently unemployed (Barnes et al., 2013).

3. Data

We utilize data from two sources: the Current Population Survey (CPS) and the National Health and Nutrition Survey (NHANES).

3.1. CPS and the ESI

As our primary measure of economic insecurity, we use the Economic Security Index (ESI) developed at Yale University's *Institution for Social and Policy Studies* and described in Hacker et al. (2012). The ESI is derived from the U.S. Current Population Survey (CPS), in which household incomes can be linked year-to-year by residence. The ESI is defined as the proportion of individuals in a given demographic group who experience a year-to-year decline of at least 25% of available household income (adjusted for household size, out-of-pocket medical expenses, household debt service, and the buffering effect of wealth, but excluding retirement events). Though the ESI is available annually since 1986, we use a 5-year moving average in our analysis, for three reasons: First, we are interested in using the ESI as a proxy for perceived economic insecurity. It seems likely to us that perceptions of threats to material well-being are likely to be based not just on current-year experience, but also on experienced insecurity in recent years (Smith et al., 2009). Second, the highest-quality obesity data are available only as 2- and 3-year samples, making annual analysis infeasible. Third, given the many dimensions along which we allow ESI to vary, the CPS cell size becomes quite small in some cases, diminishing the precision of our ESI

estimates. Using a 5-year average ameliorates all of these concerns. In some regressions we also use demographic-group-level estimates of the unemployment rate; for purposes of comparability we also construct these from the CPS as 5-year averages.

3.2. National Health and Nutrition Examination Survey (NHANES)

The NHANES is an ongoing survey that provides individual-level measured height and weight (along with other demographic and health information) for nationally representative repeated cross-sections of the U.S. civilian population. Our data begin with the six-year NHANES III survey (1988–1994), which can be subdivided into two nationally representative 3-year samples (1988–1991 and 1992–1994), and continue with the "continuous NHANES," published as representative 2-year samples from 1999 to 2012. This gives us a total of nine time periods spanning a time in which obesity rates rapidly increased in the U.S.

4. Results

Table 1 lists summary statistics for our data, by year. Table 2 shows the effects of controlling for individual characteristics and both demographic and year fixed effects. The coefficient on ESI is positive and statistically significant in every specification, for both men and women. We focus on extensions of specifications (4) and (5) in subsequent analysis.

Table 3 breaks out the marginal effects of ESI on obesity by race/ethnicity, age, and employment status. It is notable that nearly every estimate is positive, though at this resolution some are not statistically significant.

In Table 4 we test the robustness of our estimates to the use of alternative measures of body mass as dependent variable. BMI is a continuous variable representing body mass index calculated from measured height and weight; and 10-year weight change is self-reported (asked of individuals 35 years and older in NHANES) and measured in pounds. The coefficient on ESI is positive and statistically significant in nearly every case.

Table 5 shows the effect of controlling for group (mean) income and group unemployment rate. Taken together, the results suggest that our estimates of the effect of ESI on obesity are robust to controls for these covariates.

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Table 1: Summary Statistics by Year

	1990	1993	1999	2001	2003	2005	2007	2009	2011
					Men				
Economic Security Index	0.164	0.173	0.170	0.179	0.185	0.192	0.194	0.204	0.205
Obese	0.182	0.214	0.271	0.268	0.301	0.318	0.341	0.362	0.356
White Non-Hispanic	0.462	0.380	0.482	0.535	0.554	0.528	0.508	0.510	0.450
Black Non-Hispanic	0.251	0.287	0.183	0.202	0.202	0.234	0.211	0.196	0.310
Hispanic	0.287	0.334	0.334	0.263	0.244	0.238	0.281	0.293	0.240
Age 20-34	0.305	0.311	0.234	0.249	0.262	0.266	0.234	0.238	0.268
Age 35-49	0.234	0.251	0.245	0.283	0.237	0.264	0.246	0.258	0.238
Age 50-64	0.191	0.178	0.220	0.227	0.201	0.215	0.264	0.260	0.265
Age 65+	0.270	0.261	0.301	0.241	0.300	0.255	0.257	0.244	0.230
Employed	0.635	0.634	0.602	0.651	0.585	0.658	0.604	0.590	0.566
Unemployed	0.051	0.045	0.023	0.032	0.037	0.029	0.036	0.077	0.072
Married	0.695	0.692	0.697	0.684	0.668	0.676	0.662	0.654	0.602
Never Married	0.172	0.172	0.164	0.172	0.182	0.163	0.177	0.173	0.223
High School	0.274	0.281	0.216	0.231	0.255	0.243	0.258	0.248	0.235
Some College	0.153	0.158	0.207	0.238	0.260	0.268	0.239	0.261	0.287
College	0.130	0.135	0.163	0.216	0.180	0.188	0.185	0.202	0.210
Income/Poverty Ratio	2.70	2.52	2.95	2.97	2.79	2.85	2.83	2.82	2.62
Household Size	3.29	3.26	3.12	3.20	2.99	3.05	3.10	3.23	3.10
Observations	3,896	3,515	1,770	2,157	2,131	2,163	2,622	2,730	2,134
					Women				
Economic Security Index	0.207	0.216	0.192	0.199	0.205	0.209	0.218	0.223	0.220
Obese	0.266	0.317	0.375	0.351	0.369	0.396	0.402	0.416	0.449
White Non-Hispanic	0.459	0.416	0.434	0.541	0.559	0.517	0.476	0.505	0.434
Black Non-Hispanic	0.266	0.306	0.212	0.205	0.210	0.254	0.218	0.188	0.324
Hispanic	0.275	0.277	0.354	0.254	0.231	0.229	0.306	0.307	0.242
Age 20-34	0.290	0.304	0.233	0.243	0.227	0.256	0.225	0.246	0.240
Age 35-49	0.246	0.268	0.264	0.281	0.246	0.261	0.258	0.270	0.245
Age 50-64	0.196	0.176	0.231	0.223	0.221	0.236	0.255	0.240	0.282
Age 65+	0.268	0.252	0.272	0.253	0.306	0.247	0.261	0.243	0.233
Employed	0.495	0.483	0.480	0.500	0.460	0.516	0.497	0.488	0.472
Unemployed	0.036	0.031	0.022	0.014	0.029	0.016	0.022	0.042	0.050
Married	0.540	0.525	0.526	0.574	0.522	0.551	0.532	0.530	0.494
Never Married	0.135	0.166	0.151	0.135	0.150	0.154	0.156	0.174	0.192
High School	0.325	0.339	0.235	0.237	0.261	0.243	0.242	0.224	0.212
Some College	0.157	0.171	0.240	0.291	0.283	0.306	0.276	0.301	0.331
College	0.111	0.114	0.136	0.180	0.168	0.195	0.175	0.185	0.218
Income/Poverty Ratio	2.57	2.42	2.82	2.82	2.63	2.77	2.67	2.59	2.49
Household Size	3.24	3.18	3.20	3.14	2.90	3.00	3.12	3.23	3.05
Observations	3,735	4,461	1,793	2,118	2,099	2,018	2,693	2,856	2,159

Table 2: Impact of Economic Security on Obesity by Gender

	(1)	(2)	(3)	(4)	(5)
			Men		
Economic Security Index	1.152***	1.347***	2.849***	0.582**	0.494*
	(0.205)	(0.220)	(0.241)	(0.268)	(0.279)
Employed		-0.00814	-0.0480***	-0.0446***	-0.0450***
		(0.0121)	(0.00876)	(0.00881)	(0.00879)
Unemployed		0.0188	-0.0192	-0.0148	-0.0168
		(0.0178)	(0.0161)	(0.0160)	(0.0160)
Income/Poverty Ratio		0.0335***	0.0449***	0.0526***	0.0530***
		(0.00957)	(0.00901)	(0.00885)	(0.00894)
Square of Income/Poverty Ratio		-0.00434***	-0.00662***	-0.00797***	-0.00811***
		(0.00159)	(0.00150)	(0.00149)	(0.00150)
Married		0.0486***	0.0497***	0.0546***	0.0539***
		(0.0101)	(0.00993)	(0.00987)	(0.00985)
Never Married		-0.0333***	0.000830	5.88e-06	0.000239
		(0.0125)	(0.0117)	(0.0115)	(0.0115)
High School		0.0417***	0.0290***	0.0263***	0.0260***
		(0.00883)	(0.00824)	(0.00828)	(0.00827)
Some College		0.0656***	0.0449***	0.0370***	0.0360***
		(0.00920)	(0.00829)	(0.00846)	(0.00849)
College		0.00946	-0.0150	-0.0214**	-0.0226**
		(0.0117)	(0.0105)	(0.0103)	(0.0105)
R-squared	0.089	0.015	0.038	0.043	0.048
Observations	324	23,118	23,118	23,118	23,118
			Women		
Economic Security Index	1.811***	1.544***	1.976***	1.083***	1.422***
	(0.209)	(0.229)	(0.345)	(0.363)	(0.449)
Employed		-0.00311	-0.0374***	-0.0352***	-0.0357***
		(0.0110)	(0.00789)	(0.00785)	(0.00789)
Unemployed		0.0106	-0.0205	-0.0173	-0.0154
		(0.0201)	(0.0188)	(0.0189)	(0.0190)
Income/Poverty Ratio		-0.0160	-0.00801	0.00112	0.000359
		(0.0100)	(0.00886)	(0.00880)	(0.00885)
Square of Income/Poverty Ratio		0.000474	-0.00152	-0.00296**	-0.00292*
		(0.00165)	(0.00148)	(0.00148)	(0.00149)
Married		-0.00897	-0.0119	-0.0112	-0.0124
		(0.00923)	(0.00790)	(0.00781)	(0.00782)
Never Married		-0.0388**	0.00628	-0.00113	-0.00277
		(0.0151)	(0.0113)	(0.0111)	(0.0112)
High School		-0.00398	-0.0109	-0.0128	-0.0118
		(0.0101)	(0.00894)	(0.00882)	(0.00891)
Some College		0.0149	0.0104	-0.0137	-0.0138
		(0.0114)	(0.00920)	(0.00920)	(0.00912)
College		-0.0594***	-0.0715***	-0.0944***	-0.0940***
		(0.0125)	(0.0108)	(0.0109)	(0.0110)
R-squared	0.184	0.020	0.057	0.069	0.073
Observations	324	23,932	23,932	23,932	23,932
Group FEs	No	No	Yes	Yes	Yes
Year FEs	No	No	No	Yes	Yes
Group*Year FEs	No	No	No	No	Yes

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Robust standard errors that account for within group by year correlation in parentheses. The first specification is run on data aggregated at the group level. A quadratic in household size is also included in the covariates but not presented.

Table 3: Heterogeneous Impacts of Economic Security on Obesity

	(1)	(2)	(3)	(4)
	Men		Women	
A) Economic Security Index Interacted with Race/Ethnicity				
White	0.352	1.791*	0.842**	1.402***
	(0.296)	(0.924)	(0.413)	(0.431)
Black	0.845**	1.982*	1.980**	1.437
	(0.344)	(1.024)	(0.774)	(0.901)
Hispanic	0.528	-1.874	0.994**	2.012
	(0.578)	(1.247)	(0.450)	(1.635)
R-squared	0.044	0.048	0.069	0.073
B) Economic Security Index Interacted with Age Group				
Age 20-24	0.558	0.421	0.575	1.156**
	(0.519)	(0.419)	(0.404)	(0.545)
Age 25-29	1.663***	1.303**	1.252**	1.793***
	(0.472)	(0.529)	(0.487)	(0.578)
Age 30-34	1.198***	0.795*	1.452***	1.921***
	(0.433)	(0.453)	(0.509)	(0.624)
Age 35-39	1.338***	0.474	1.086**	1.345**
	(0.488)	(0.587)	(0.515)	(0.582)
Age 40-44	0.113	-0.154	1.113**	1.609***
	(0.441)	(0.436)	(0.440)	(0.598)
Age 44-49	0.687	0.157	1.596***	2.109***
	(0.490)	(0.498)	(0.533)	(0.572)
Age 50-54	-0.218	-0.368	1.300***	1.621***
	(0.444)	(0.506)	(0.480)	(0.575)
Age 55-59	0.178	-0.413	0.790	1.146*
	(0.590)	(0.773)	(0.492)	(0.597)
Age 60-64	0.524	-0.263	0.900**	1.182**
	(0.671)	(0.598)	(0.444)	(0.575)
Age 65-69	0.155	-0.278	1.021**	1.475***
	(0.474)	(0.475)	(0.417)	(0.560)
Age 70-74	0.370	-0.687	0.656	0.879
	(0.532)	(0.538)	(0.637)	(0.745)
Age 75+	0.549*	0.648*	1.128**	1.609**
	(0.289)	(0.355)	(0.537)	(0.815)
R-squared	0.044	0.049	0.069	0.074
C) Economic Security Index Interacted with Employment Status				
Employed	0.689**	0.570*	1.143***	1.456***
	(0.310)	(0.307)	(0.374)	(0.455)
Unemployed	0.251	0.0836	0.872	1.106
	(0.641)	(0.638)	(0.687)	(0.742)
Out of Labour Force	0.547*	0.470	1.040***	1.307***
	(0.287)	(0.311)	(0.386)	(0.503)
R-squared	0.044	0.048	0.069	0.073
Observations	23,118	23,118	23,932	23,932
Group FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Group*Year FEs	No	Yes	No	Yes

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Robust standard errors that account for within group by year correlation in parentheses. All covariates from Table 2 are included in each regression.

Table 4: Impact of Economic Security on Different Measures of Weight by Gender

	(1)		(2)		(3)		(4)		(5)		(6)	
Men												
	BMI		BMI≥20		BMI≥25		BMI≥35		Waist/Height Ratio		10-yr Weight Gain	
Economic Security Index	6.757**	4.827	0.332**	0.147	0.765**	1.061**	0.0832	-0.0201	0.109***	0.105**	19.36	4.650
	(2.660)	(3.101)	(0.164)	(0.185)	(0.325)	(0.420)	(0.184)	(0.155)	(0.0415)	(0.0474)	(13.10)	(10.43)
R-squared	0.067	0.072	0.026	0.032	0.068	0.072	0.027	0.032	0.175	0.179	0.078	0.082
Observations	23,118	23,118	23,118	23,118	23,118	23,118	23,118	23,118	22,226	22,226	15,934	15,934
Women												
	BMI		BMI≥20		BMI≥25		BMI≥35		Waist/Height Ratio		10-yr Weight Gain	
Economic Security Index	18.37***	19.46***	0.628***	1.088***	1.161***	2.011***	0.484*	-0.0786	0.174**	0.260**	40.66	98.76***
	(4.779)	(5.336)	(0.202)	(0.343)	(0.340)	(0.410)	(0.247)	(0.244)	(0.0766)	(0.123)	(24.82)	(34.61)
R-squared	0.098	0.103	0.031	0.036	0.087	0.092	0.045	0.052	0.162	0.169	0.087	0.092
Observations	24,207	24,207	24,207	24,207	24,207	24,207	24,207	24,207	23,074	23,074	16,244	16,244
Group FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Group*Year FEs	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Robust standard errors that account for within group by year correlation in parentheses. All covariates from Table 2 are included in each regression.

Table 5: Robustness of Main Results to Controlling for Other Economic Shocks

	(1)	(2)	(3)	(4)	(5)	(6)
			Men			
Economic Security Index	0.576**	0.521*	0.799***	0.739*	0.766***	0.742*
	(0.266)	(0.281)	(0.275)	(0.440)	(0.282)	(0.422)
Employed	-0.0443***	-0.0450***	-0.0443***	-0.0450***	-0.0442***	-0.0450***
	(0.00881)	(0.00879)	(0.00880)	(0.00879)	(0.00881)	(0.00879)
Unemployed	-0.0151	-0.0168	-0.0150	-0.0167	-0.0151	-0.0167
	(0.0160)	(0.0160)	(0.0160)	(0.0160)	(0.0160)	(0.0160)
Income/Poverty Ratio	0.0529***	0.0530***	0.0540***	0.0531***	0.0539***	0.0531***
	(0.00885)	(0.00895)	(0.00889)	(0.00894)	(0.00888)	(0.00895)
Square of Income/Poverty Ratio	-0.0080***	-0.0081***	-0.0082***	-0.0081***	-0.0082***	-0.0081***
	(0.00149)	(0.00150)	(0.00149)	(0.00150)	(0.00149)	(0.00150)
Group Unemployment Rate	0.551*	0.116			0.328	0.0243
	(0.294)	(0.393)			(0.308)	(0.425)
Group Income/Poverty Ratio			0.0653**	0.0374	0.0563**	0.0371
			(0.0269)	(0.0407)	(0.0286)	(0.0436)
R-squared	0.044	0.048	0.044	0.048	0.044	0.048
Observations	23,118	23,118	23,118	23,118	23,118	23,118
			Women			
Economic Security Index	1.104***	1.349***	1.104***	1.120	1.114***	1.137
	(0.370)	(0.450)	(0.385)	(0.765)	(0.389)	(0.783)
Employed	-0.0352***	-0.0356***	-0.0352***	-0.0356***	-0.0352***	-0.0356***
	(0.00785)	(0.00789)	(0.00785)	(0.00789)	(0.00785)	(0.00789)
Unemployed	-0.0173	-0.0154	-0.0173	-0.0155	-0.0173	-0.0154
	(0.0189)	(0.0190)	(0.0189)	(0.0190)	(0.0189)	(0.0190)
Income/Poverty Ratio	0.00120	0.000312	0.00121	0.000288	0.00124	0.000273
	(0.00876)	(0.00886)	(0.00879)	(0.00886)	(0.00877)	(0.00886)
Square of Income/Poverty Ratio	-0.00297**	-0.00291*	-0.00298**	-0.00290*	-0.00298**	-0.00290*
	(0.00147)	(0.00149)	(0.00147)	(0.00149)	(0.00147)	(0.00149)
Group Unemployment Rate	-0.105	0.151			-0.0897	0.0986
	(0.365)	(0.298)			(0.365)	(0.316)
Group Income/Poverty Ratio			0.00392	-0.0121	0.00241	-0.00951
			(0.0182)	(0.0224)	(0.0179)	(0.0244)
R-squared	0.069	0.073	0.069	0.073	0.069	0.073
Observations	23,932	23,932	23,932	23,932	23,932	23,932
Group FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Group*Year FEs	No	Yes	No	Yes	No	Yes

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Robust standard errors that account for within group by year correlation in parentheses. All covariates from Table 2 are included in each regression.