

The Dynamic Effects of Obesity on the Wages of Young Workers

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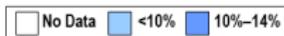
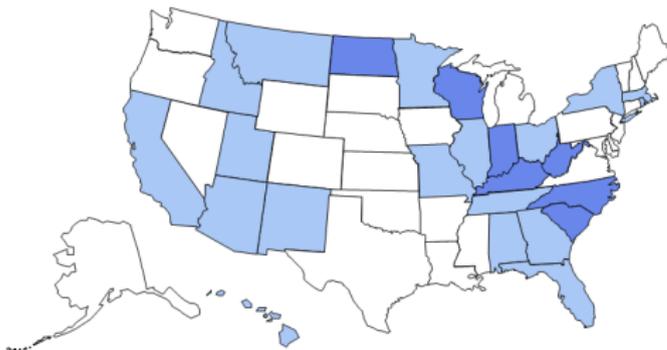
University of Louisville

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Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 1986

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



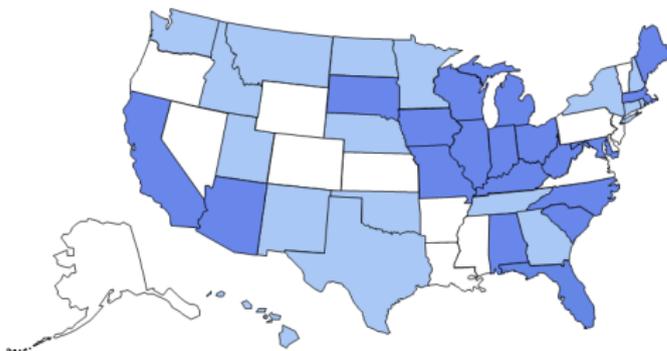
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 1988

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



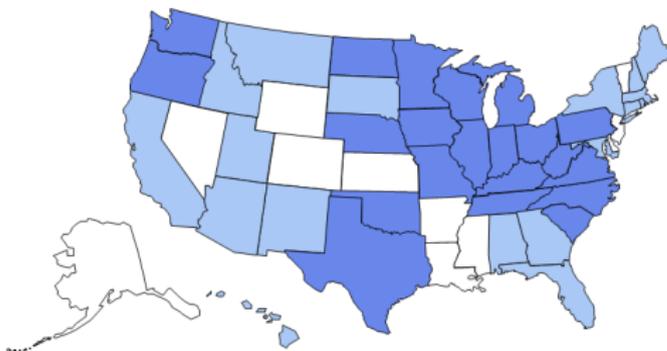
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 1989

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



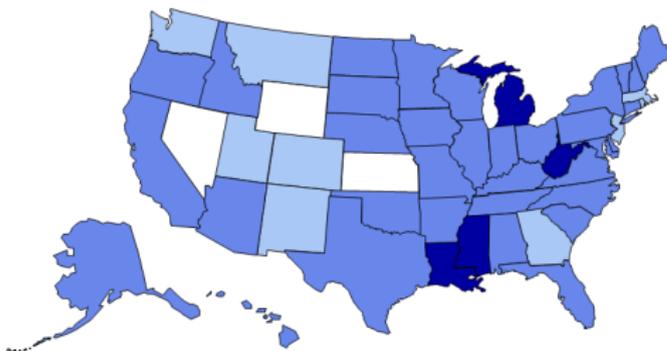
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 1991

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



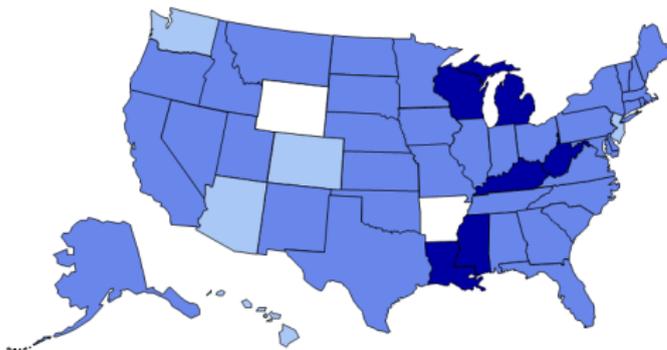
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 1992

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



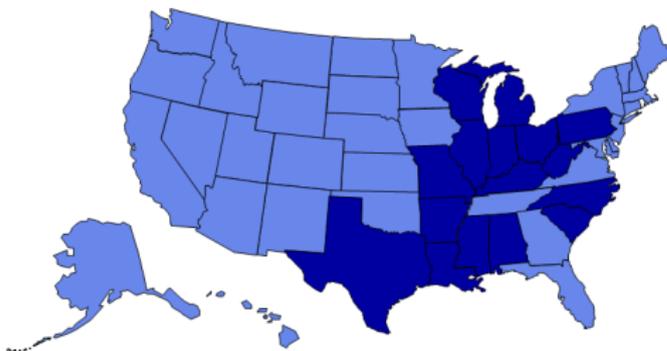
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 1994

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



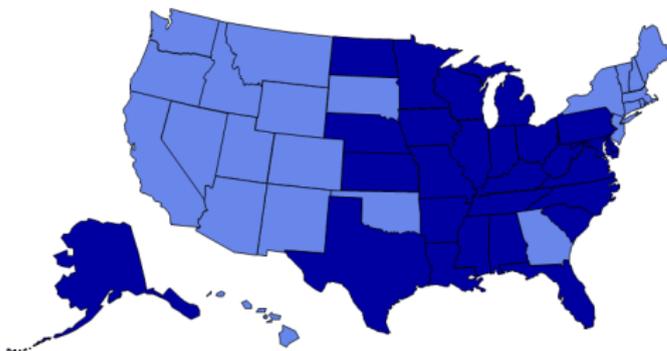
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 1995

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



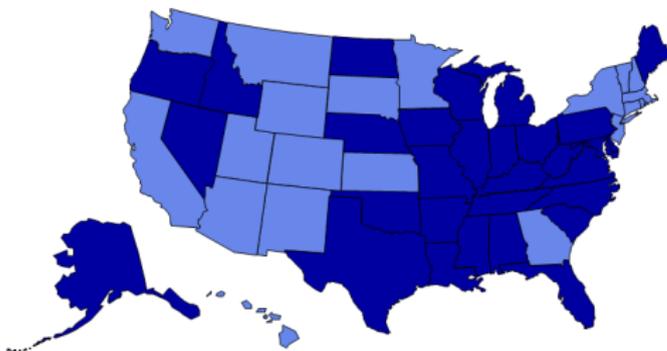
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 1996

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



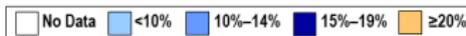
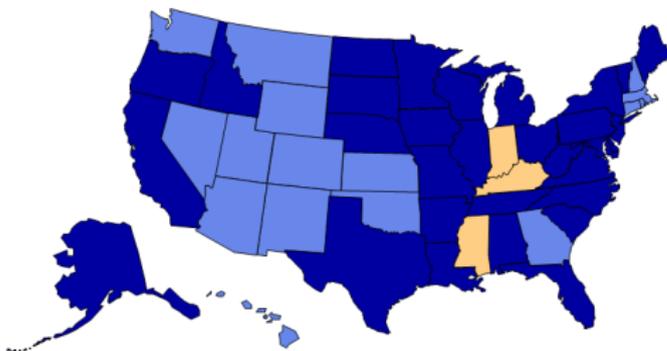
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 1997

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



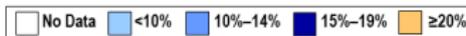
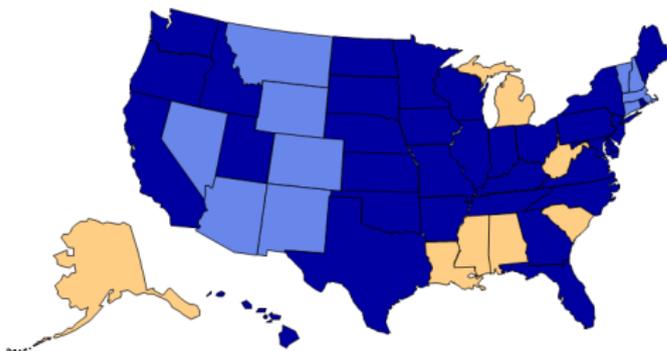
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 1998

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



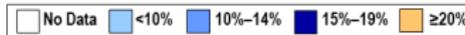
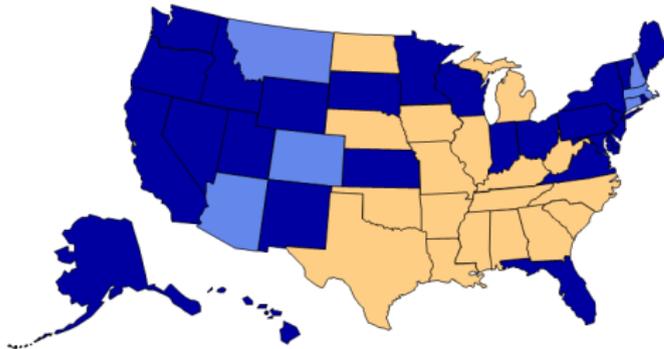
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 1999

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



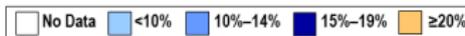
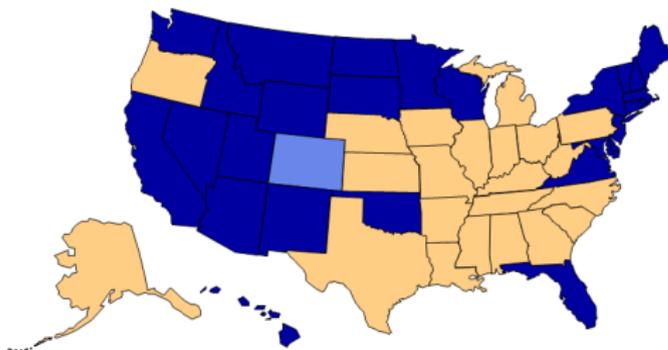
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 2000

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



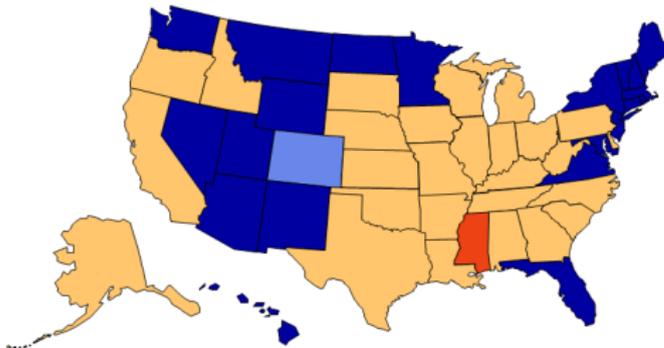
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 2001

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



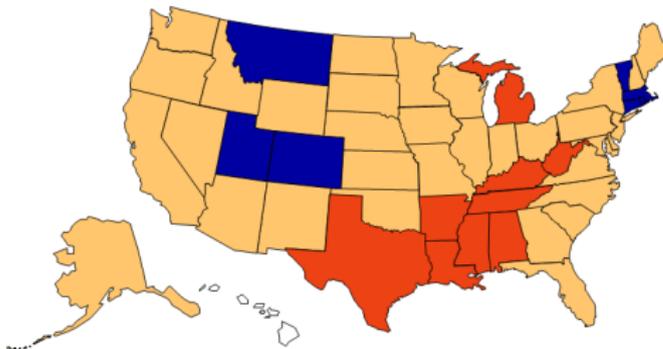
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 2004

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



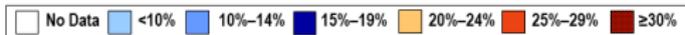
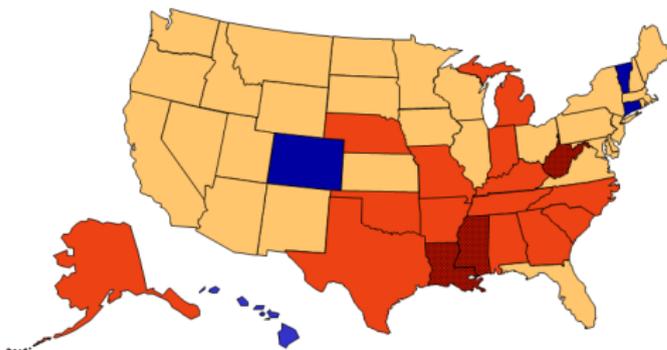
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 2005

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



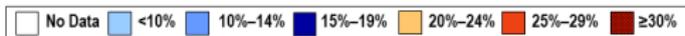
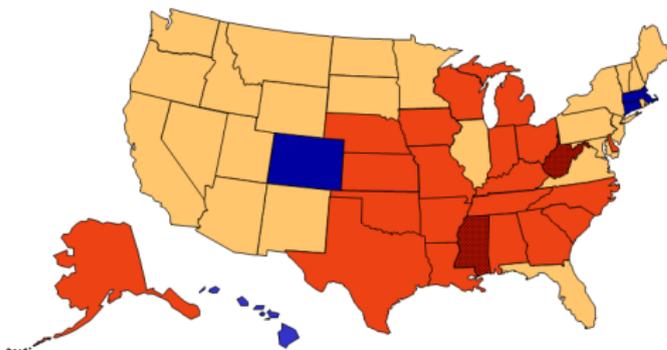
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 2006

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



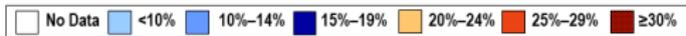
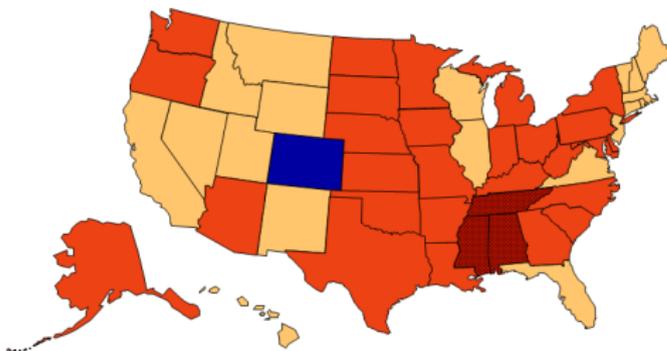
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 2007

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



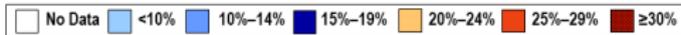
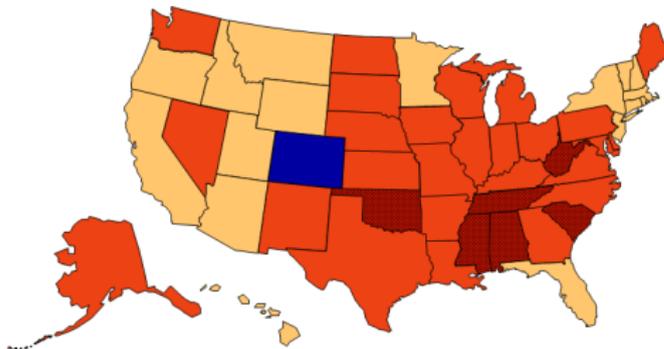
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 2008

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



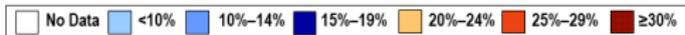
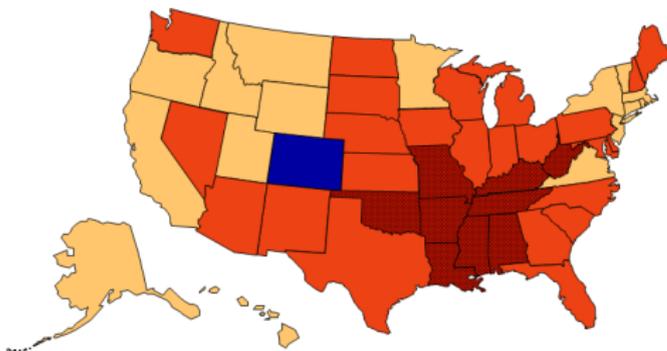
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 2009

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



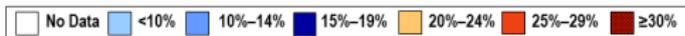
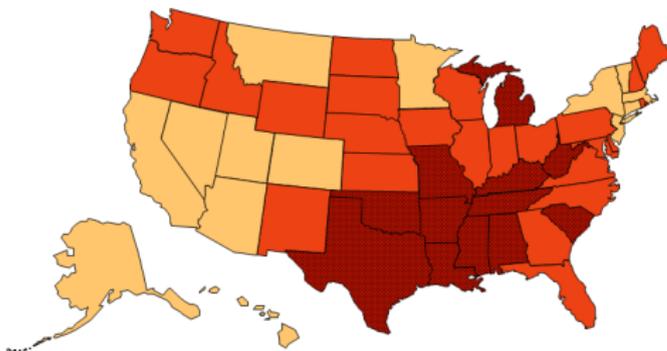
Source: Behavioral Risk Factor Surveillance System, CDC.



Prevalence of Obesity has Increased Dramatically

Obesity Trends* Among U.S. Adults BRFSS, 2010

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



Source: Behavioral Risk Factor Surveillance System, CDC.



Contributions

1. Focus on more recent cohort, NLSY97.
 - Obesity in US doubled between 1980 & 2000.
 - Industry mix, worker characteristics, etc. have varied over time.
2. Focus on young workers, shortly after labor market entry
 - More likely to observe discrimination as it unfolds.
 - Wage penalties less likely to reflect disability.

Contributions

3. More realistic, dynamic model of wages:

- Current and past BMI affect wages.*
- Past wages also affect current wages.
⇒ Effects of BMI can persist and accumulate.

*BMI = weight in kilograms \div (height in meters)²

Preview of Results

- Lagged body mass matters more than current.
 - Lagged severe obesity lowers wages of white men by 17%.
 - White women face 10% penalty for lagged BMI ≥ 24.5 , plus additional 10% for heaviest women.
 - Current BMI only matters for severely obese women.
- Dynamic models matter.
 - Especially for women.
 - Penalties do persist and accumulate.

Following Recent Literature

- Start with a simple wage regression:

$$w_{it} = X_{it}\beta + BMI_{it}\phi + v_{it}, \quad (1)$$

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$$w_{it} = X_{it}\beta + BMI_{it}\phi + v_{it}, \quad (1)$$

- **Problem:** BMI_{it} may be correlated with v_{it} .
 - Fixed effects related to genetics or upbringing.
 - Time-varying unobservables, reverse causality, etc.
 - Predetermined?

What Have Others Done?

- Instrumental variables
 - BMI of family member.
 - Problems: Only predicts time-invariant components of BMI.
Correlated with time-invariant unobservables.

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- Instrumental variables
 - BMI of family member.
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Correlated with time-invariant unobservables.
- FE or Differencing
 - Removes bias from fixed effects.
 - Problems: Time-varying unobservables, labor market history.

What Have Others Done?

Chen (2012)

- Only other paper to consider both current and lagged BMI.
 - Uses NLSY79.
 - Regresses wage in 30s on current BMI and BMI 10 years prior.
 - Finds early BMI matters, especially for women.
- Results for men appear biased by time-invariant unobservables.
 - No mention of time-varying sources of bias.
 - No control for past wages.

Including Effects of the Past

- Obvious first step: Add lagged BMI
- Should also add lagged wage.
- Adding one lag of each yields:

$$w_{it} = \gamma w_{it-1} + X_{it}\beta + BMI_{it}\phi + BMI_{it-1}\phi_1 + \alpha_i + \varepsilon_{it}. \quad (2)$$

- Problems:
 - w_{it-1} , BMI_{it} , and BMI_{it-1} could be correlated with α_i .
 - BMI_{it} could be correlated with ε_{it} .

Difference GMM

Developed by Holtz-Eakin *et al.* (1988), Arellano & Bond (1991)
Basic Idea:

1. Difference to eliminate α_i

$$\Delta w_{it} = \gamma \Delta w_{it-1} + \Delta X_{it} \beta + \Delta BMI_{it} \phi + \Delta BMI_{it-1} \phi_1 + \Delta \varepsilon_{it}. \quad (3)$$

2. Use further lagged levels (w_{it-2} , BMI_{it-2} , etc.) as IVs.

Assumes:

- No serial correlation in ε_{it} .
- BMI_{it} uncorrelated with ε_{it+1} .

Testing for Potential Problems

- AB test for serial correlation in residuals
- Tests of overidentifying restrictions.
 - Hansen J -test.
 - "Difference-in-Hansen" tests.
- Less formal: Robustness to changes in health status.

NLSY97

1997-2009 waves.

- Respondents are 12-16 years old in 1996. 24-30 in 2009.
- Sample restrictions:
 - Only white men and women.
 - Only use jobs following full-time labor market entry.
 - First two consecutive years working full time for 75% of year.
 - Focus is on early careers, not summer jobs.
 - Never in military.
 - Drop women if pregnant since last interview.

Summary Statistics

From Table 1

	White Men		White Women	
	Mean	Std. Dev.	Mean	Std. Dev.
Wage	19.89	356.12	11.05	21.53
Log Wage	2.33	0.62	2.20	0.56
BMI	26.72	5.52	25.81	6.66
Overweight	0.57	0.49	0.42	0.49
Obese	0.22	0.42	0.20	0.40
Severely Obese	0.08	0.27	0.10	0.30
Yrs since LM Entry	4.47	2.66	4.05	2.49
Yrs in 2009	7.01	2.56	6.19	2.51
Actual Experience	4.17	2.46	3.79	2.29
Exp in 2009	6.40	2.41	5.62	2.33
Observations	9,037		5,408	

Self-Reported BMI

And what I (don't) do about it

- Ongoing problem in this literature.
- Don't use "validation" approach used by others in literature.
 - Assumptions required are likely violated across samples.
 - Do we care about *actual* BMI?

Self-Reported BMI

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- Ongoing problem in this literature.
- Don't use "validation" approach used by others in literature.
 - Assumptions required are likely violated across samples.
 - Do we care about *actual* BMI?
- Talking on phone = Miracle weight loss?
 - 10% of estimation sample from phone interviews.
 - Include controls for phone interview in t and $t - 1$.

Selecting Specifications of BMI

- No reason to assume penalties coincide with WHO categories.
- I consider alternative thresholds ranging from 23 to 38.
- Preferred specifications selected based on
 - 1 Robustness of coefficients to changes in specifications & estimation sample.
 - 2 Formal specification tests:
 - Bond et al. (2001) for nested specifications.
 - Andrews & Lu (2001) for non-nested.

Effects of Past & Current BMI on $\ln(\text{wage})$ of White Men

WHO Categories (from Table 2)

	(1)	(2)	(3)	(4)	(5)	(6)
L. $\ln(\text{wage})$	0.0722* (0.0414)	0.0605 (0.0410)	0.0648 (0.0416)	0.0769* (0.0420)	0.0720* (0.0412)	0.0768* (0.0421)
Overweight	-0.1187 (0.1198)	-0.0977 (0.1224)	...	...	-0.1190 (0.1207)	...
L.Overweight	0.0540 (0.0491)	0.0477 (0.0456)	...	...	0.0549 (0.0470)	...
Obese	0.0112 (0.0979)	...	0.0054 (0.1021)	...	...	-0.0051 (0.1012)
L.Obese	0.0030 (0.0567)	...	0.0175 (0.0576)	...	...	0.0061 (0.0600)
Severely Obese	0.0465 (0.0927)	...	...	0.0745 (0.0938)	0.0557 (0.0925)	0.0360 (0.0951)
L. Severely Obese	-0.1699*** (0.0632)	...	...	-0.1649*** (0.0598)	-0.1722*** (0.0594)	-0.1668** (0.0680)

Effects of Past & Current BMI on $\ln(\text{wage})$ of Women

Alternative Categories (from Table 4)

	Lower Dummy Variable: BMI \geq 24.5				Lower Dummy Variable: BMI \geq 25			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L. $\ln(\text{wage})$	0.214*** (0.059)	0.221*** (0.055)	0.222*** (0.053)	0.221*** (0.054)	0.231*** (0.057)	0.233*** (0.055)	0.226*** (0.053)	0.230*** (0.055)
Lower BMI Var.	0.050 (0.148)	0.067 (0.096)	0.018 (0.084)	0.027 (0.091)	0.076 (0.055)	0.100* (0.058)	0.080 (0.072)	0.064 (0.077)
L.(Lower BMI Var.)	-0.112*** (0.039)	-0.104** (0.045)	-0.103** (0.043)	-0.098** (0.040)	-0.082** (0.040)	-0.082* (0.044)	-0.086** (0.041)	-0.081** (0.039)
BMI \geq 36.5	...	-0.101 (0.093)	...	...	...	-0.099 (0.086)	...	...
L.(BMI \geq 36.5)	...	-0.048 (0.056)	...	...	...	-0.032 (0.056)	...	...
BMI \geq 37	...	...	-0.126** (0.054)	...	...	...	-0.133** (0.057)	...
L.(BMI \geq 37)	...	...	-0.097* (0.055)	...	...	...	-0.068 (0.057)	...
BMI \geq 37.5	...	...	...	-0.048 (0.068)	...	...	...	-0.064 (0.073)
L.(BMI \geq 37.5)	...	...	...	-0.052 (0.054)	...	...	...	-0.031 (0.053)

Differences Between the Results for Men & Women

Societal expectations, muscle mass & the beauty premium



The Importance of Dynamic Models

- Past body mass affects wages beyond the lags in the model.
 - w_{it-1} is a function of BMI_{it-2} and w_{it-2} .
 - w_{it-2} is a function of BMI_{it-3} , etc.
- Penalty for high BMI is persistent & accumulates.

Years in Market:		$t = 1$	$t = 2$	$t = 3$
Woman 1	BMI	38	29	24
	Penalty	13%	20%	15%
Woman 2	BMI	23	29	24
	Penalty	0	0	10%

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Woman 2	BMI	23	29	24
	Penalty	0	0	10%
Woman 3	BMI	38	38	38
	Penalty	13%	33%	37.5%

Robustness to Additional Control Variables

The results are robust to the inclusion of

- Self-reported health
 - Past or current
 - Implications for identification
- Employer-provided health insurance.
- Marital status, number & age of children.
- Hours worked.
- Tenure & training.

Robustness to Additional Control Variables

Occupation does matter, but it's endogenous

	<u>White Men</u>		<u>White Women</u>	
	Preferred Model	Occupation Added	Preferred Model	Occupation Added
L.ln(wage)	0.072* (0.041)	0.072* (0.041)	0.222*** (0.053)	0.217*** (0.047)
Overweight or BMI \geq 24.5	-0.119 (0.121)	-0.085 (0.113)	0.018 (0.084)	0.008 (0.087)
L.(Overweight or BMI \geq 24.5)	0.055 (0.047)	0.051 (0.046)	-0.103** (0.043)	-0.078* (0.046)
Obese or BMI \geq 37	0.056 (0.093)	0.065 (0.114)	-0.126** (0.054)	-0.081 (0.052)
L.(Obese or BMI \geq 37)	-0.172*** (0.059)	-0.214*** (0.079)	-0.097* (0.055)	-0.055 (0.054)

Slow Adjustments & Indirect Effects

- Lagged effects suggest something other than simple disutility-based penalty.
- Already some work on indirect effects:
 - Han et al. (2011): Effects of teen BMI on education and occupation.
 - Lakdawalla & Philipson (2007), and Harris (2014) consider occupation.
 - Rooth (2009): Field study, finds obesity affects response to female job applicants.