Untangling the Direct and Indirect Effects of Body Mass Dynamics on Earnings

Donna B. Gilleskie, Univ of North Carolina

Euna Han, Univ of Illinois at Chicago

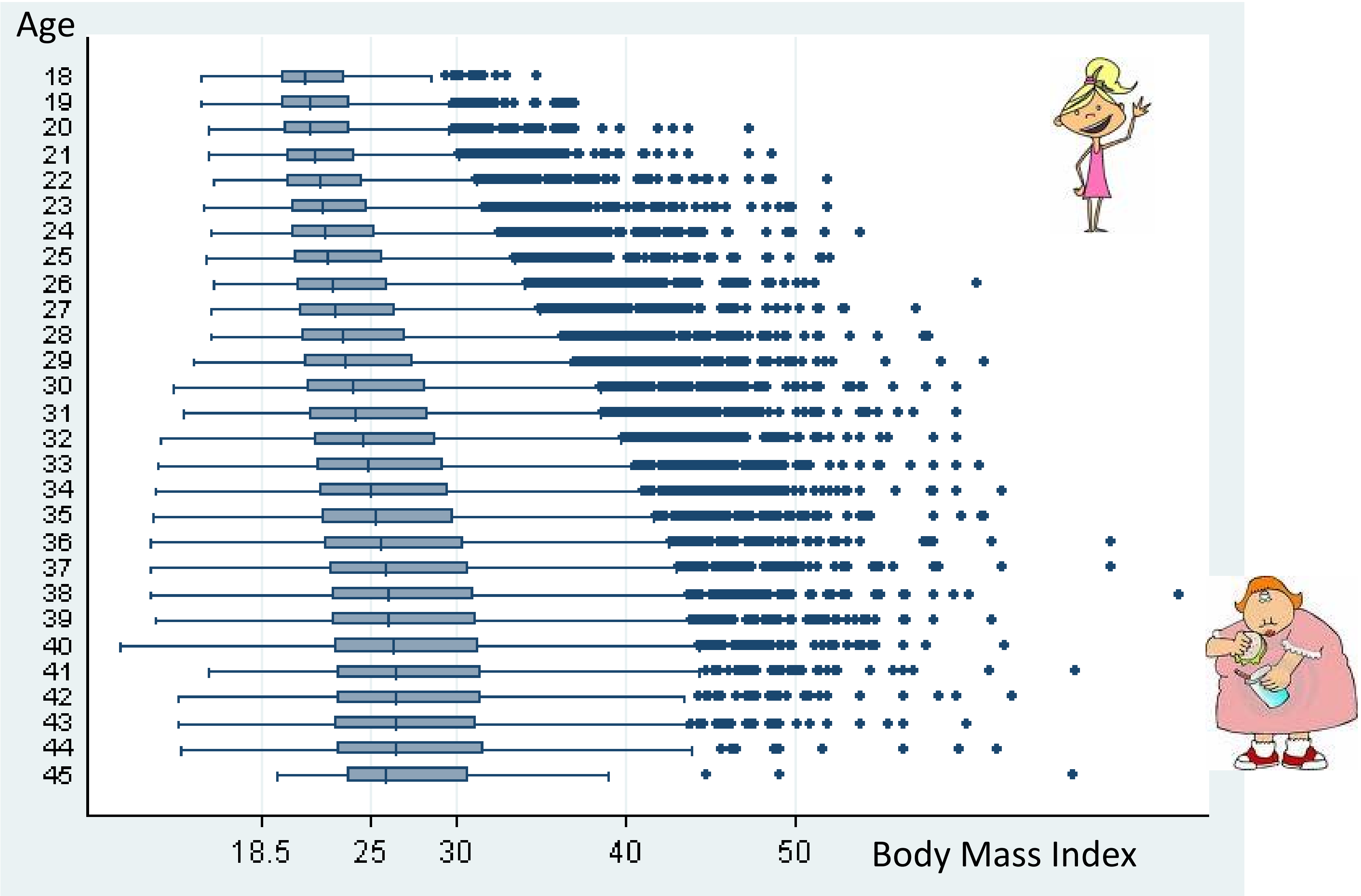
Edward C. Norton, Univ of Michigan

October 20, 2010

Veteran's Administration Cyber Seminar

Body Mass of Females as we Age

(same individuals followed over time)

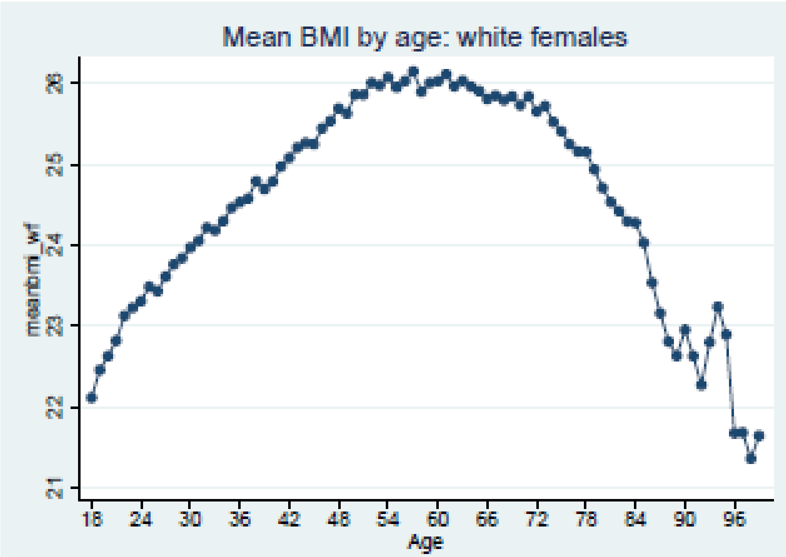


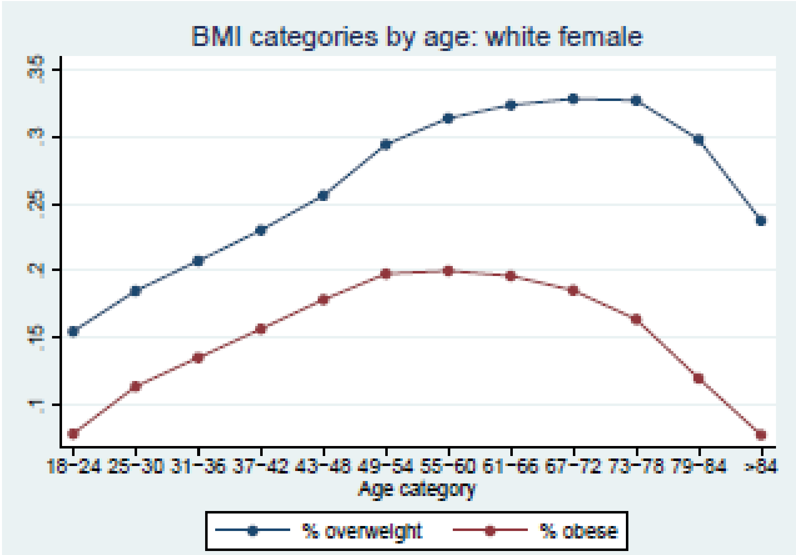
Flow of presentation

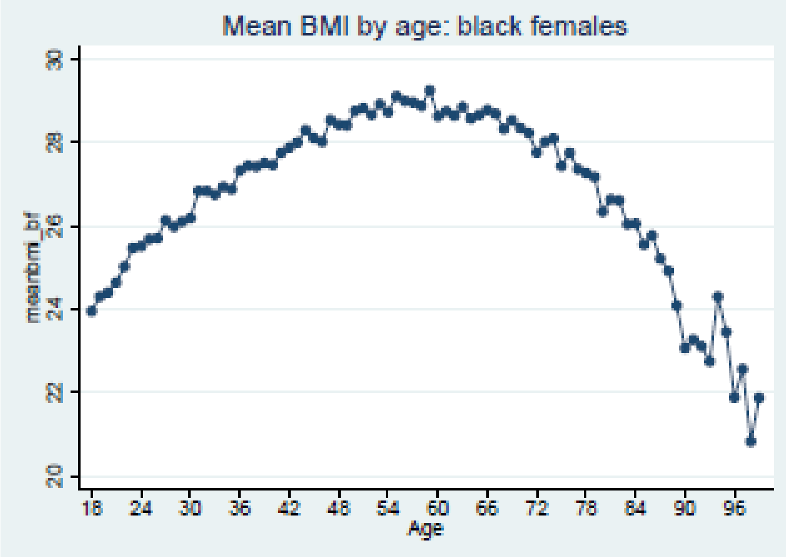
1. A closer look at body mass
2. Our model of behaviors over time that relate to body mass evolution and observed wages
3. A description of the data we use to understand the relationship between body mass and wages
4. Unobserved individual heterogeneity
5. Conditional Density Estimation
6. Preliminary results and discussion

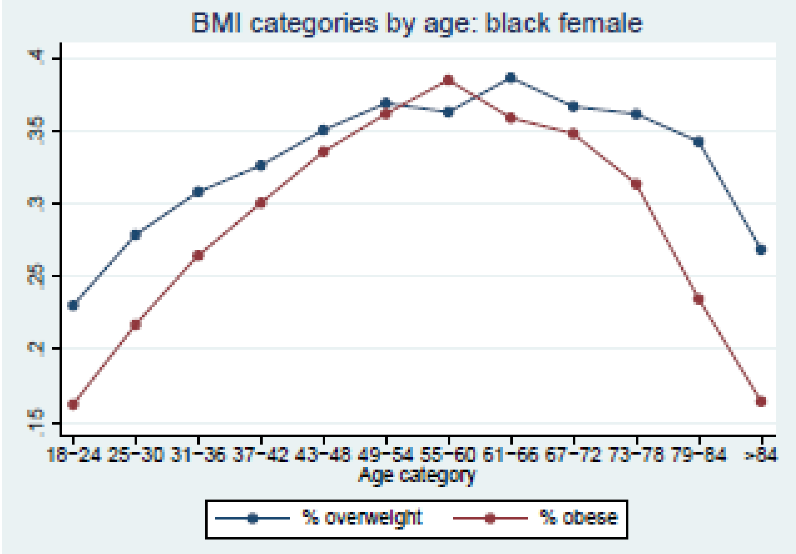
Description of Average Body Mass by Age

(using repeated cross sections from NHIS data)



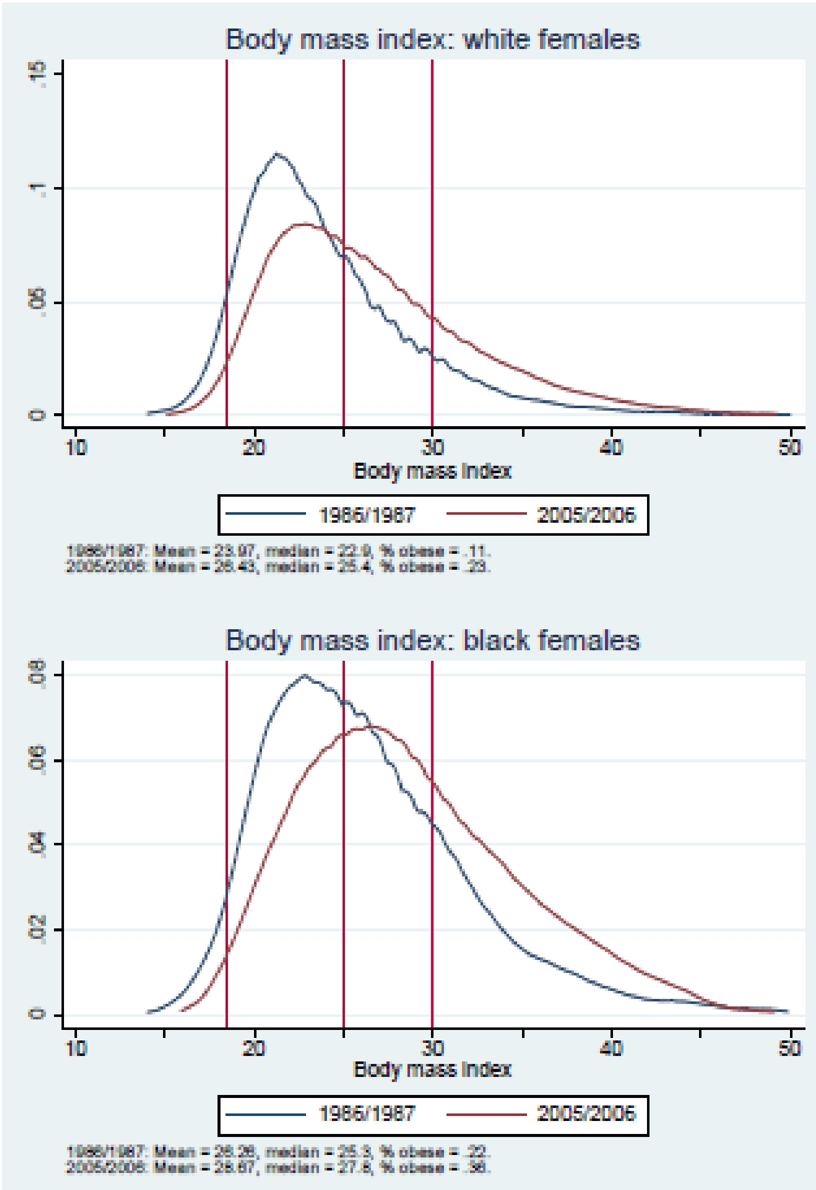






Source: DiNardo, Garlick, Stange (2010 working paper)

Empirical Distribution of the Body Mass Index



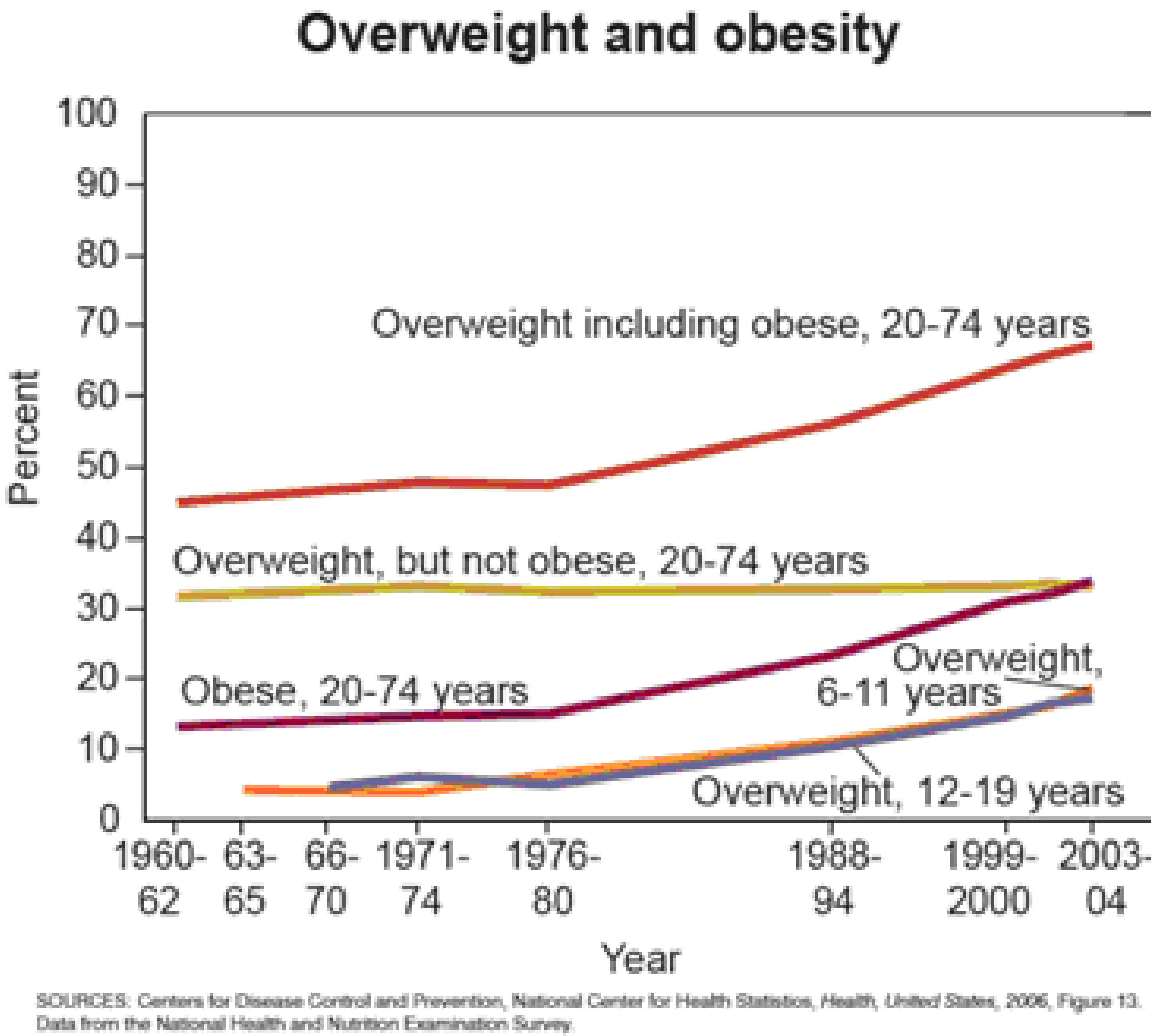
- The distribution of BMI
  (among the US adult female population)
  is changing over time.

- The mean and median
  have increased significantly.

- The right tail has thickened
  (larger percent obese).

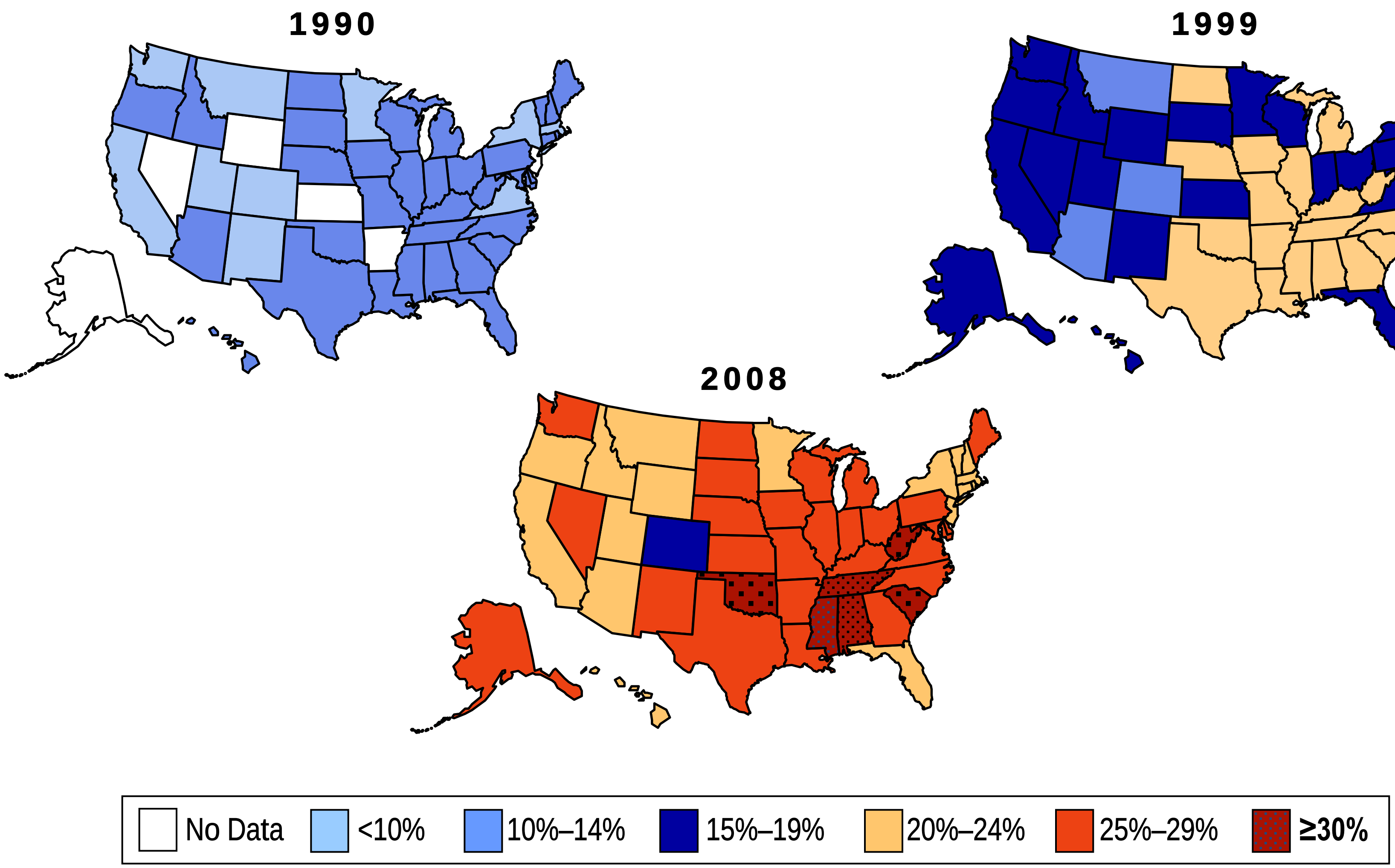
Source: DiNardo, Garlick, Stange (2010 working paper)

Trends in Body Mass over time



Obesity Trends* Among U.S. Adults
BRFSS, 1990, 1999, 2008

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



Body Mass Index

$$\mathrm{BMI} = \frac{\text{weight (kg)}}{\text{height}^2(\mathrm{m}^2)} \qquad \mathrm{BMI} = \frac{\text{weight (lb)} \times 703}{\text{height}^2(\mathrm{in}^2)}$$

Calories in **<** Calories out

Calories in **>** Calories out

Caloric Intake:
food and drink

Caloric Expenditure:
requirement to sustain life and exercise

Advantages of the Body Mass Index

- A function of weight & height;
  independent of age & gender *(among adults)*

- A commonly used diagnostic tool to identify weight problems

  (original proponents stressed its use in population studies and considered it inappropriate for individual diagnosis)

- A simple means for classifying *(sedentary)* individuals
  - BMI < 18.5: underweight
  - 18.5 to 25: ideal weight
  - 25 to 30: overweight
  - BMI 30+: obese

- Available in nationally representative data sets

Concerns with using the Body Mass Index

- A function of self-reported weight and height
  - subjective measure, rounding issues, but can apply correction
- Does not fully capture, or capture correctly, adiposity
  - may overestimate on those with more lean body mass (e.g. athletes)
  - and underestimate on those with less lean body mass (e.g. the elderly)
- Other measures of "fatness"?
  - percentage of body fat (skinfold, underwater weighing, fat-free mass index)
  - measures that account for mass and volume location (body volume index)
- Does the functional relationship restrict measurement of the effect of body mass on wages?
- Should weight and height be included separately/flexibly?

Body Mass and Wages

- Evidence in the economic literature that wages of white women are negatively correlated with BMI.
- Evidence that wages of white men, white women, and black women are negatively correlated with body fat (and positively correlated with fat-free mass).
- Evidence of a height-related wage premium.

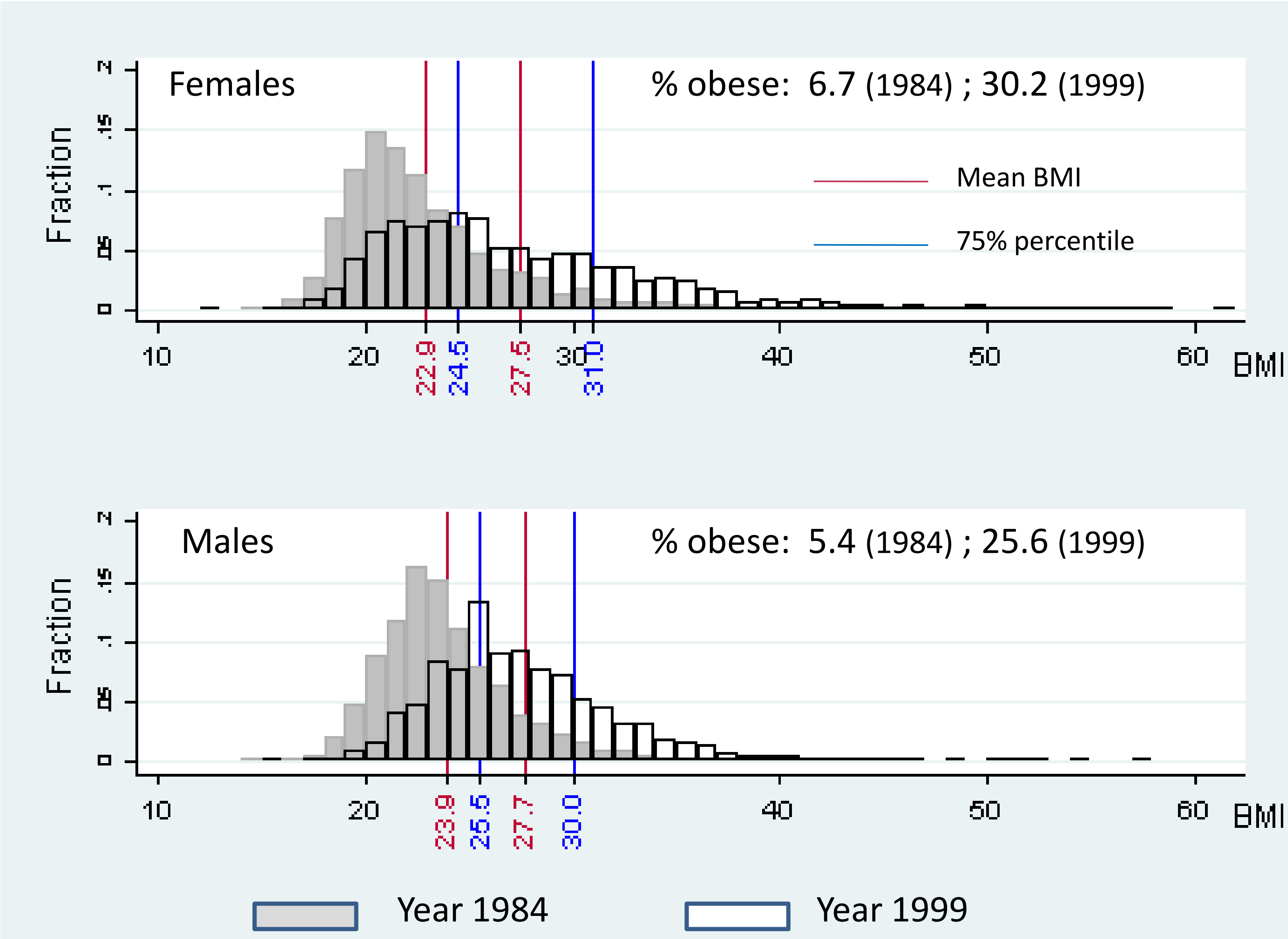
Potential Problems…

- Cross sectional data: we don't want a snapshot of what's going on, but rather we want to follow the *same* individuals *over time*.
- Endogenous body mass: to the extent that individual *permanent* unobserved characteristics as well as *time-varying* ones influence both BMI and wages, we want to measure *unbiased* effects.
- Confounders: BMI might affect other variables that also impact wages; hence we want to *model all avenues* through which BMI might explain differences in wages.

An analogous situation…

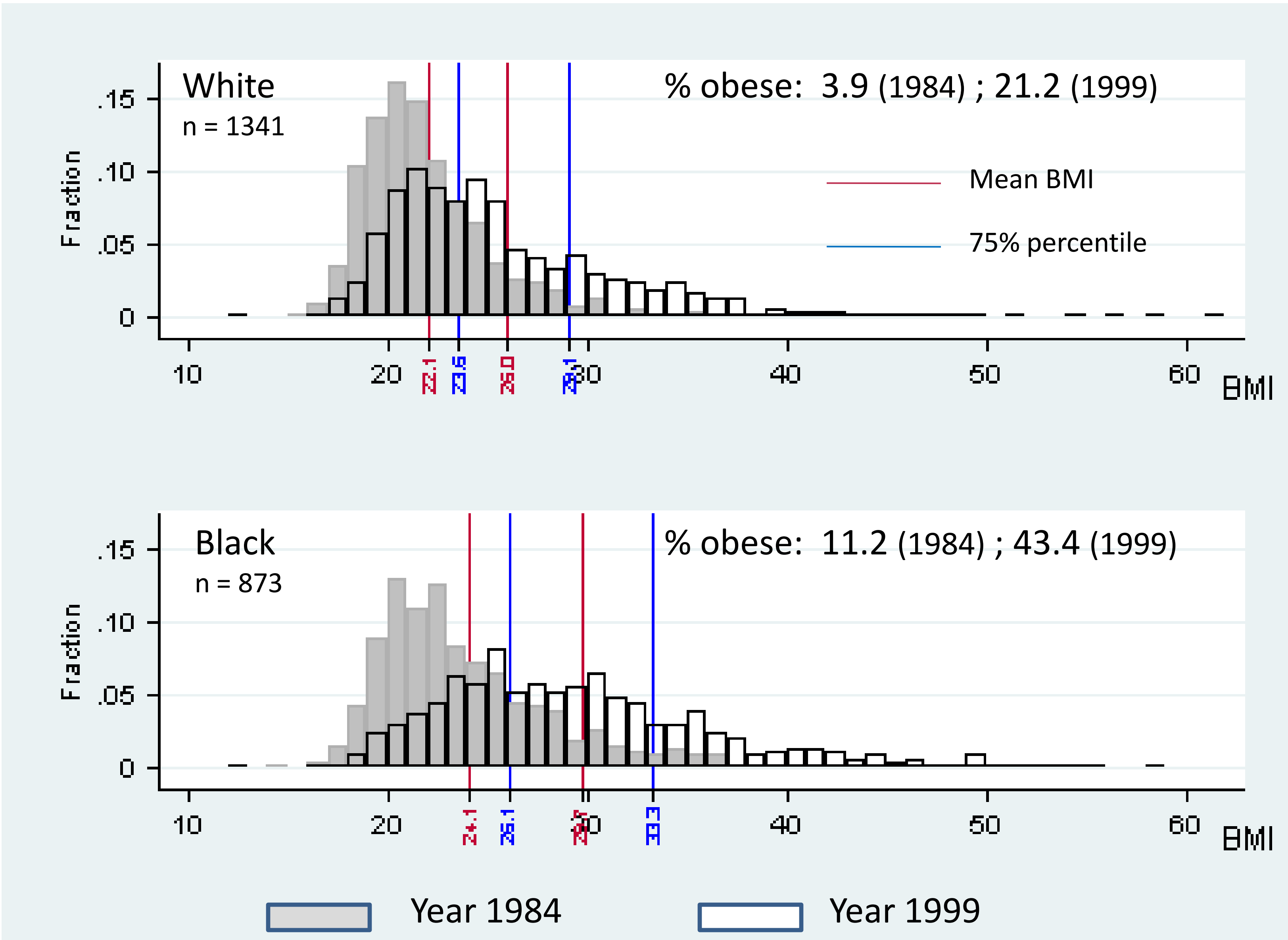
- We may want to understand the effect of body mass on medical care expenditures.
- Body mass and medical care expenditures both tend to rise with age…and perhaps both decrease at oldest ages.
- Medical care expenditures are observed only if an individual consumes medical care.
- Other endogenous factors affect medical care expenditures that may also be influenced by body mass.

Body Mass Index Distribution
of *same* individuals in 1984 and 1999

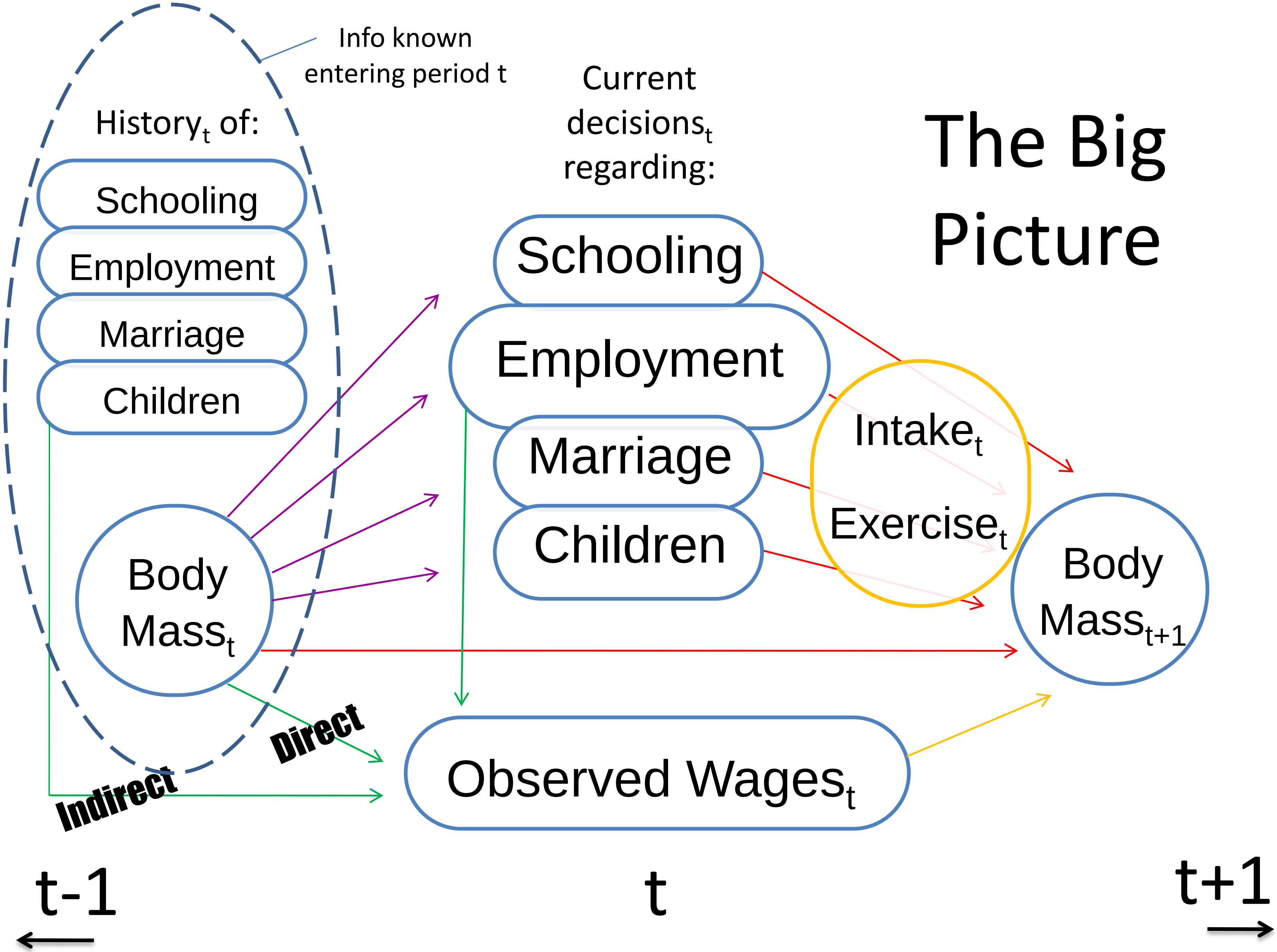


Source: NLSY79

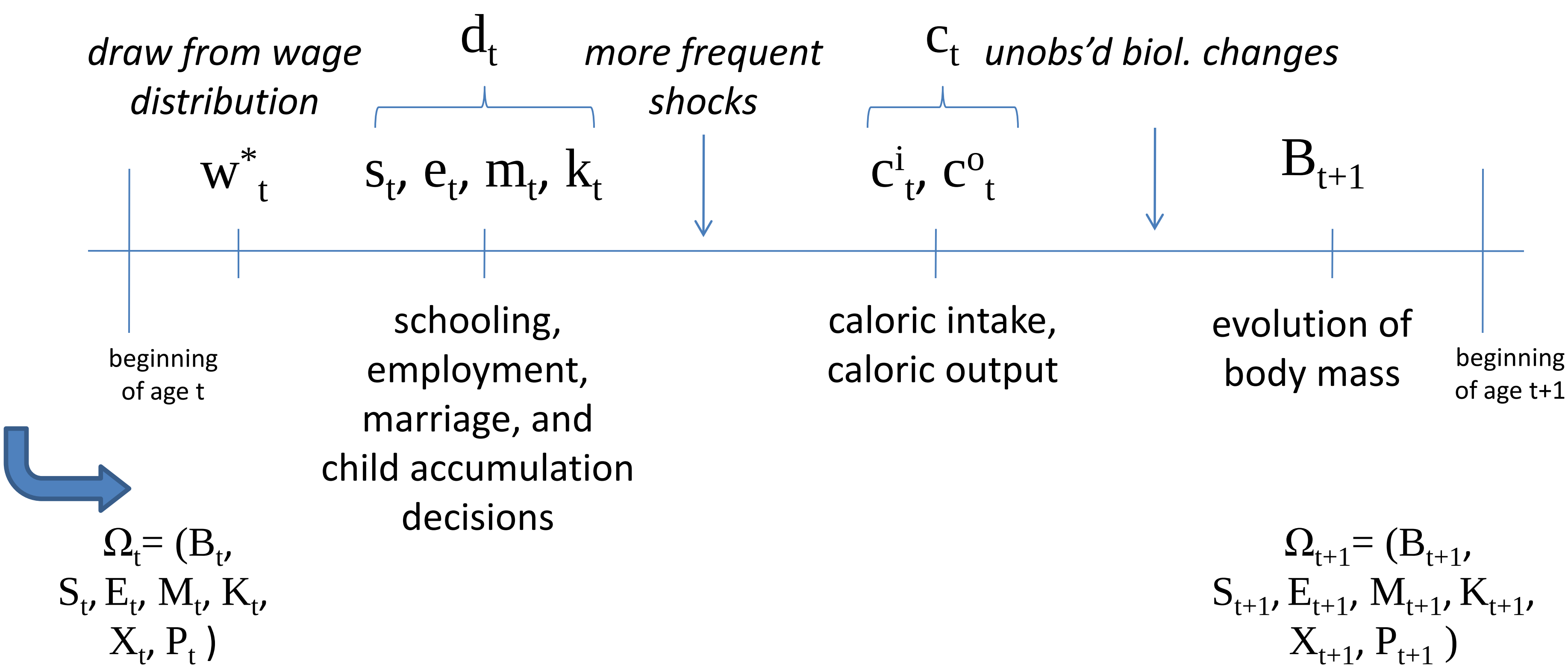
Body Mass Index Distribution
of *same* females in 1984 and 1999



Source: NLSY79


Info known entering period t
History$_t$ of:
Schooling
Employment
Marriage
Children
Body Mass$_t$
Current decisions$_t$ regarding:
Schooling
Employment
Marriage
Children
The Big Picture
Intake$_t$
Exercise$_t$
Body Mass$_{t+1}$
Observed Wages$_t$
Direct
Indirect
t-1
t
t+1

Model of behavior of individuals as they age



$$d_t = d(\Omega_t, P^d_t, P^c_t) + e^d_t$$

$$w_t \mid e_t = w(\Omega_t) + e^w_t$$

$$\cancel{c_t = c(\Omega_t, d_t, w_t, P^c_t) + e^c_t}$$

$$B_{t+1} = b(B_t, c^i_t, c^o_t) + e^b_t \quad = b'(\Omega_t, d_t, w_t, P^c_t) + e^b_t$$

Data: National Longitudinal Survey of Youth (NLSY)

Year	Sample Size	Number of Attriters	Attrition Rate
1983	8,526	-	-
1984	8,526	241	2.82
1985	8,285	277	3.34
1986	8,008	320	3.99
1987	7,688	286	3.72
1988	7,402	169	2.28
1989	7,233	182	2.51
1990	7,051	145	2.05
1991	6,906	152	2.20
1992	6,754	107	1.58
1993	6,647	142	2.13
1994	6,505	267	4.10
1995	6,238	214	3.43
1996	6,024	212	3.51
1997	5,812	236	4.06
1998	5,576	122	2.18
1999	5,454	321	5.88
2000	5,133	86	1.67
2001	5,047	281	5.56
2002	4,766	-	-

Number of person-year observations: 125,055

Information entering period t (endogenous state variables)

$\Omega_t = (B_t, S_t, E_t, M_t, K_t, X_t, P_t)$

Variable name	Male Mean	Male Std Dev	Female Mean	Female Std Dev
Education history S_t				
Enrolled in $t-1$	0.179	0.383	0.171	0.376
Years enrolled in school missing	0.017	0.129	0.012	0.108
Years enrolled in school entering t	13.679	2.293	13.834	2.413
No HS degree: yrs enrolled $<$ 12 entering t	0.039	0.194	0.029	0.164
HS degree: yrs enrolled $\geq$ 12 entering t	0.961	0.194	0.971	0.164
College degree: yrs enrolled $\geq$ 16 entering t	0.238	0.426	0.248	0.432
Freshmen year of college in t	0.014	0.117	0.014	0.117
Employment history E_t				
Employed in $t-1$	0.906	0.291	0.816	0.388
Employed full time in $t-1$	0.761	0.426	0.572	0.495
Employed part time in $t-1$	0.145	0.352	0.244	0.430
Years employed entering t	10.567	5.795	9.648	5.649
Years full time employed entering t	7.869	5.812	5.948	5.251
Years part time employed entering t	2.699	2.305	3.700	2.868

Information entering period t (endogenous state variables)

$$\Omega_t = (B_t, S_t, E_t, M_t, K_t, X_t, P_t)$$

Variable name	Male Mean	Male Std Dev	Female Mean	Female Std Dev
Marital history M_t				
Married in $t-1$	0.469	0.499	0.511	0.500
Years married entering t if married in $t-1$	3.392	4.965	3.930	5.334
Years newly single entering t if single in $t-1$	0.227	1.028	0.434	1.551
Child history K_t				
Number of children entering t	0.784	1.136	1.278	1.235
Acquire any children in $t-1$	0.085	0.279	0.090	0.286
Lose any children in $t-1$	0.025	0.156	0.022	0.146

Exogenous variables X_t : race, AFQT score, non-earned income, spouse income if married, ubanicity, region, and time trend

Exogenous price and supply side variables

Variable name	Mean	Std Dev	Min	Max
Schooling variables P_t^s				
Two-year college semester tuition (hundreds)	12.145	9.175	0.100	52.370
Two-year college tuition missing indicator	0.040	0.195	0	1
Four-year college semester tuition (hundreds)	19.928	10.751	2.480	71.540
Four-year college tuition missing indicator	0.035	0.183	0	1
Graduate school semester tuition (hundreds)	19.928	12.155	3.690	73.720
Graduate school tuition missing indicator	0.144	0.351	0	1
Employment variables P_t^e				
Total employment (100 thousands)	6.052	4.679	0.260	19.660
Manufacturing employment	8.015	5.579	0.090	22.255
Service employment	17.854	15.327	0.538	68.753
Total earnings (millions)	237.404	204.472	7.681	947.313
Manufacturing earnings	43.282	33.204	0.336	155.744
Service earnings	62.909	62.327	1.117	308.139
Employment data missing	0.034	0.182	0	1

Exogenous price and supply side variables

Variable name	Mean	Std Dev	Min	Max
Marriage and Children variables P_t^m and P_t^k				
Monthly AFDC payment (hundreds)	5.217	1.698	1.471	11.867
Monthly AFDC payment missing indicator	0.149	0.356	0	1
Child care funds (millions)	0.274	0.818	0.002	7.726
Child care funds missing indictor	0.490	0.500	0	1
Per capita income (thousands)	21.446	3.426	12.688	38.180
Total population (millions)	11.036	8.528	0.454	35.025

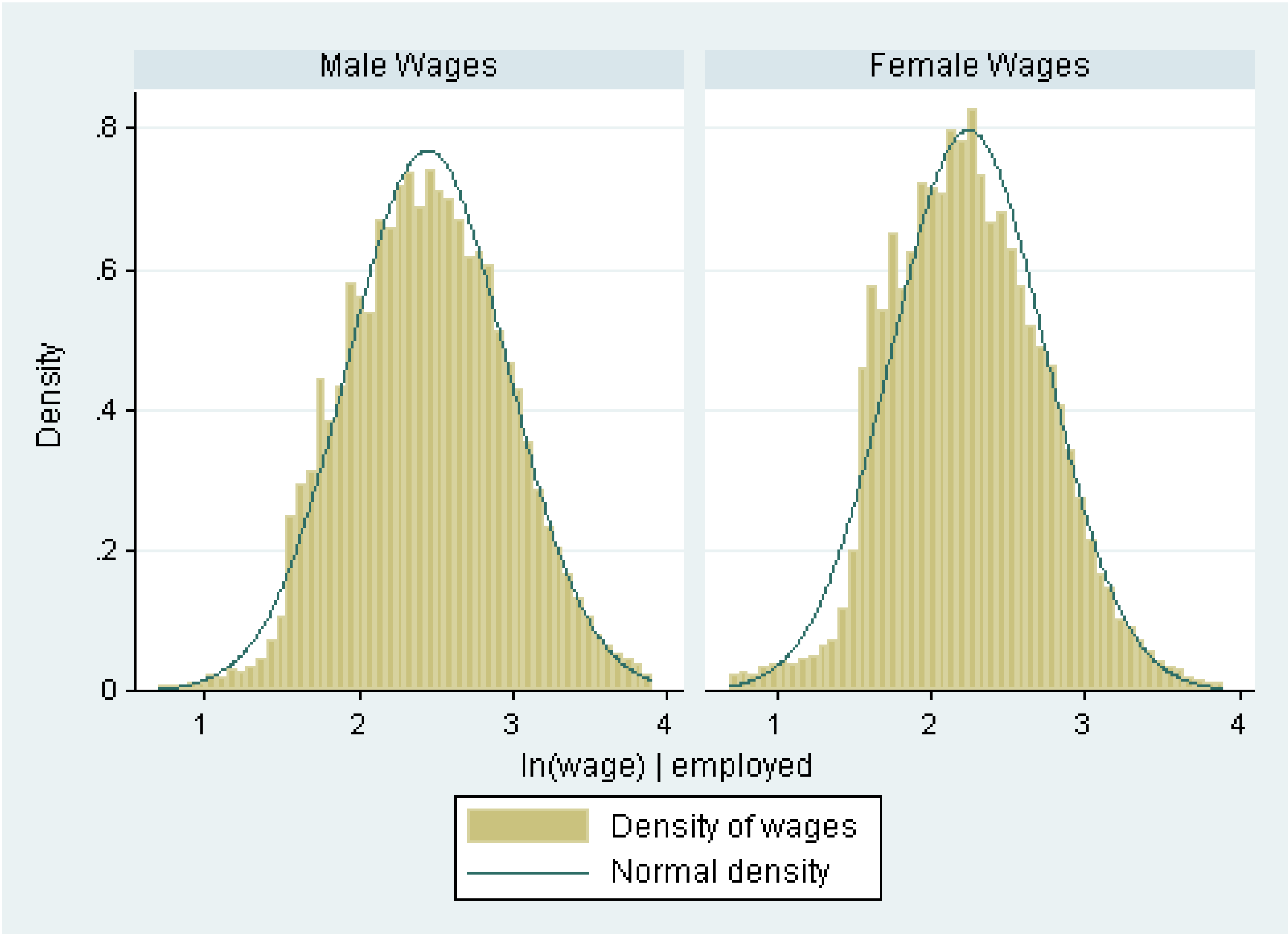
Exogenous price and supply side variables

Variable name	Mean	Std Dev	Min	Max
Consumption variables P_t^b				
Mean price of food	1.596	0.299	1.052	3.212
Mean price of junkfood	3.987	0.564	2.356	6.601
Mean price of cigarettes	16.842	7.919	2.382	51.853
Mean price of beer	4.037	1.155	1.478	9.076
Mean price of wine	5.437	0.940	3.362	8.300
Mean price of liquor	9.039	1.692	2.302	13.994
Retail sales in food stores (millions)	20.28	15.977	0.808	59.957
Retail sales in restaurants (millions)	11.347	9.458	0.416	42.428
Cost of living	1.097	0.212	0.729	2.355
Price index	1.386	0.237	1.02	1.852
Food prices and sales data missing	0.034	0.182	0	1

Decision/Outcome	Estimator	Explanatory Variables		
		Endogenous	Exogenous	Unobs'd Het
Initially observed state variables	2 logit 7 ols		X_1, P_1, Z_1	$\rho^i\mu$
Enrolled	logit	B_t, S_t, E_t, M_t, K_t	X_t, $P^s{}_t$, $P^e{}_t$, $P^m{}_t$, $P^k{}_t$, P^b	$\rho^s\mu$, $\omega^s\upsilon_t$
Employed	mlogit	B_t, S_t, E_t, M_t, K_t	X_t, $P^s{}_t$, $P^e{}_t$, $P^m{}_t$, $P^k{}_t$, P^b	$\rho^e\mu$, $\omega^e\upsilon_t$
Married	logit	B_t, S_t, E_t, M_t, K_t	X_t, $P^s{}_t$, $P^e{}_t$, $P^m{}_t$, $P^k{}_t$, P^b	$\rho^m\mu$, $\omega^m\upsilon_t$
Change in kids	mlogit	B_t, S_t, E_t, M_t, K_t	X_t, $P^s{}_t$, $P^e{}_t$, $P^m{}_t$, $P^k{}_t$, P^b	$\rho^k\mu$, $\omega^k\upsilon_t$
Wage not obs'd	logit	B_t, S_t, E_t, M_t, K_t	X_t	$\rho^n\mu$, $\omega^n\upsilon_t$
Wage if emp'd	CDE	B_t, S_t, E_t, M_t, K_t	X_t, $P^e{}_t$	$\rho^w\mu$, $\omega^w\upsilon_t$
Body Mass	CDE	B_t, S_{t+1}, E_{t+1}, M_{t+1}, K_{t+1}	X_t, P^b	$\rho^b\mu$, $\omega^b\upsilon_t$
Attrition	logit	B_{t+1}, S_{t+1}, E_{t+1}, M_{t+1}, K_{t+1}	X_t	$\rho^a\mu$, $\omega^a\upsilon_t$

What do hourly wages look like among the employed?

… and ln(wages)?



Male Wages
Female Wages
Density
.8
.6
.4
.2
0
1
2
3
4
1
2
3
4
ln(wage) | employed
Density of wages
Normal density

Empirical Model of Wages

Schooling (entering t)

$$\ln(w_t) \mid e_t \neq 0 \;=\; \eta_0 + \eta_1 S_t$$

work experience
and part time indicator

$$+ \;\; \eta_2 E_t + \eta_3 1[e_t = 1 \text{ (pt)}]$$

productivity

$$+ \;\; \eta_4 B_t + \eta_5 M_t + \eta_6 K_t$$

exogenous determinants
and changes in skill prices

$$+ \;\; \eta_7 X_t + \eta_8 P^e{}_t + \eta_9 t$$

unobserved permanent and
time varying heterogeneity

$$+ \;\; \rho^w \mu + \omega^w \nu_t + \varepsilon^w{}_t$$

Unobserved Heterogeneity Specification

- Permanent: rate of time preference, genetics
- Time-varying: unmodeled stressors

$$u^e_t = \rho^e \mu + \omega^e \nu_t + \varepsilon^e_t$$

where u^e_t is the unobserved component for equation e decomposed into

- permanent heterogeneity factor μ with factor loading ρ^e
- time-varying heterogeneity factor ν_t with factor loading ω^e
- iid component ε^e_t

  distributed $N(0,\sigma^2_e)$ for continuous equations and
  Extreme Value for dichotomous/polychotomous outcomes

Individual's optimal decisions

about schooling, employment, marriage, and child accumulation

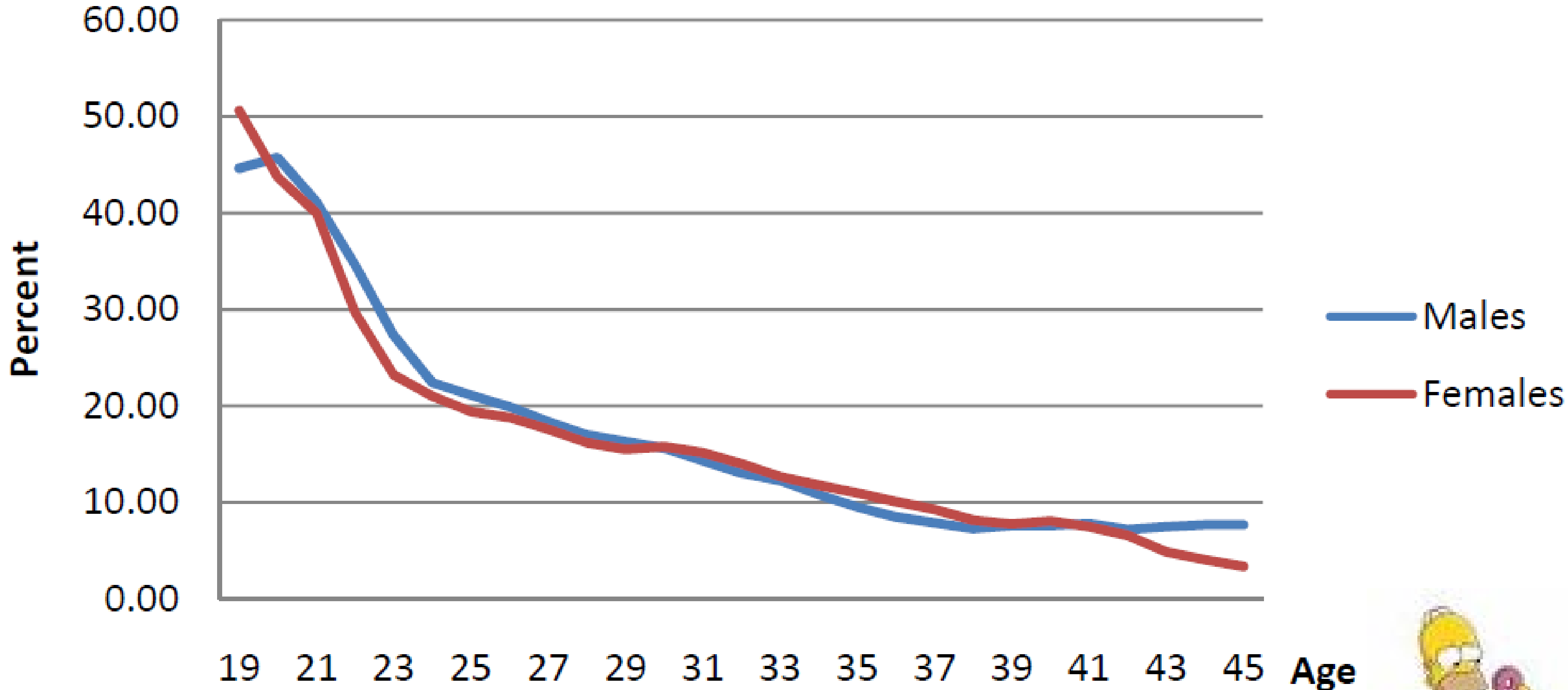
$$p(d_t^{semk} = 1|\Omega_t) = \frac{e^{\beta_{semk}\Omega_t}}{\Sigma_{(semk)'}\, e^{\beta_{(semk)'}\Omega_t}}$$

$$s = 0,1 \quad e = 0,1,2 \quad m = 0,1 \quad k = -1,0,1$$

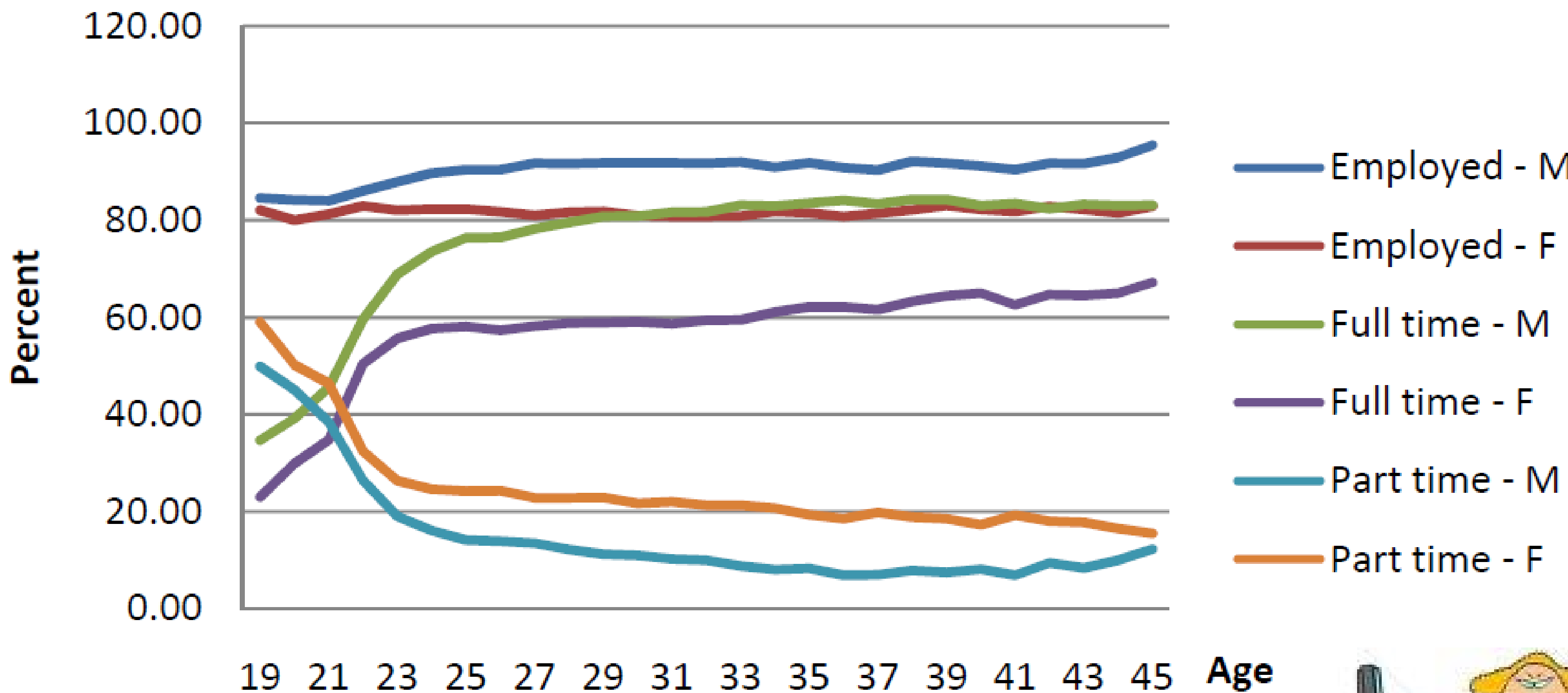
Theory suggests that these decisions are jointly made, hence the observed behaviors are modeled jointly.

Because of the number of combinations, we specify equations for each behavior but estimate them jointly (correlated by the permanent and time varying unobserved heterogeneity).

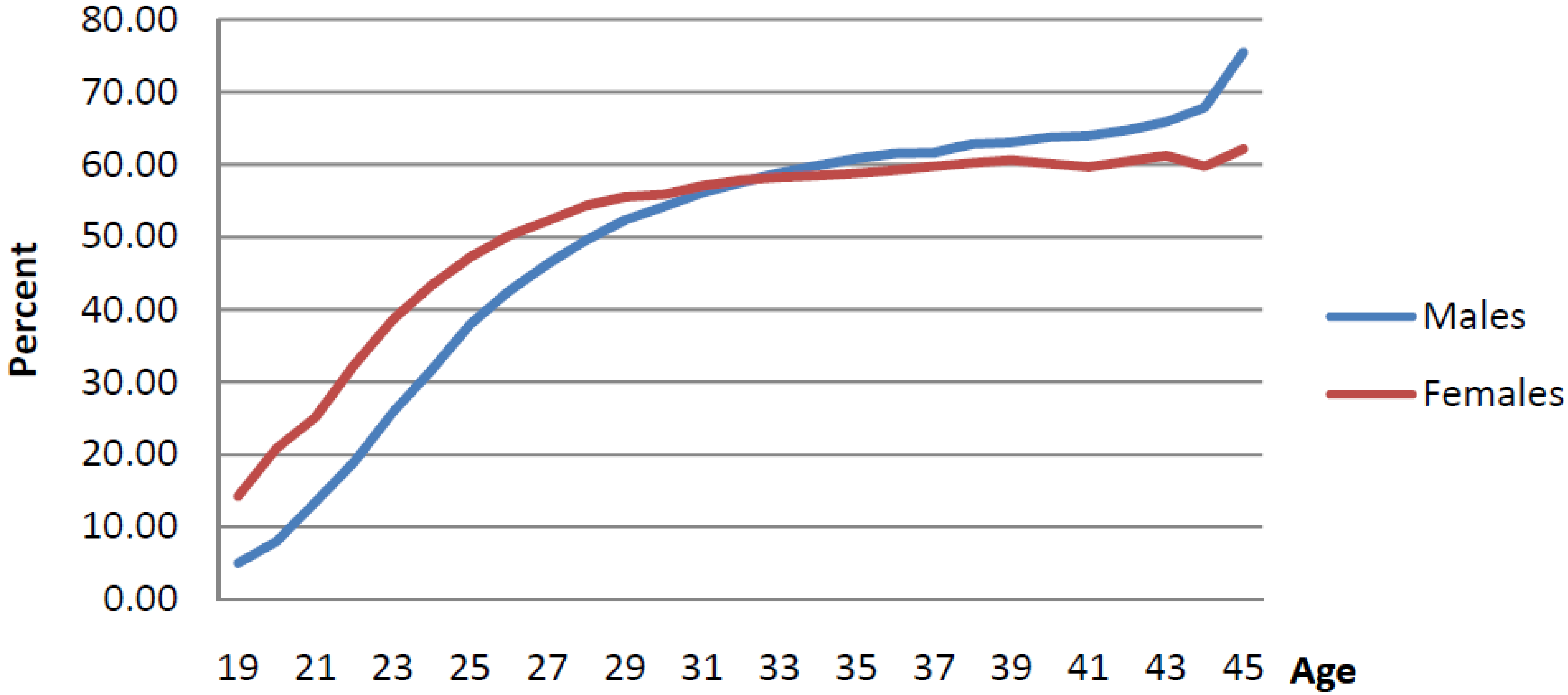
School Enrollment by Age and Gender

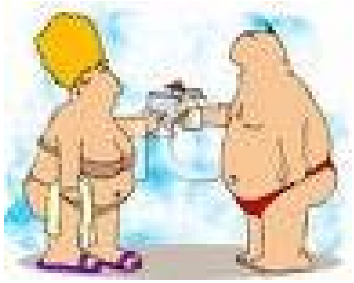


Employment by Age and Gender

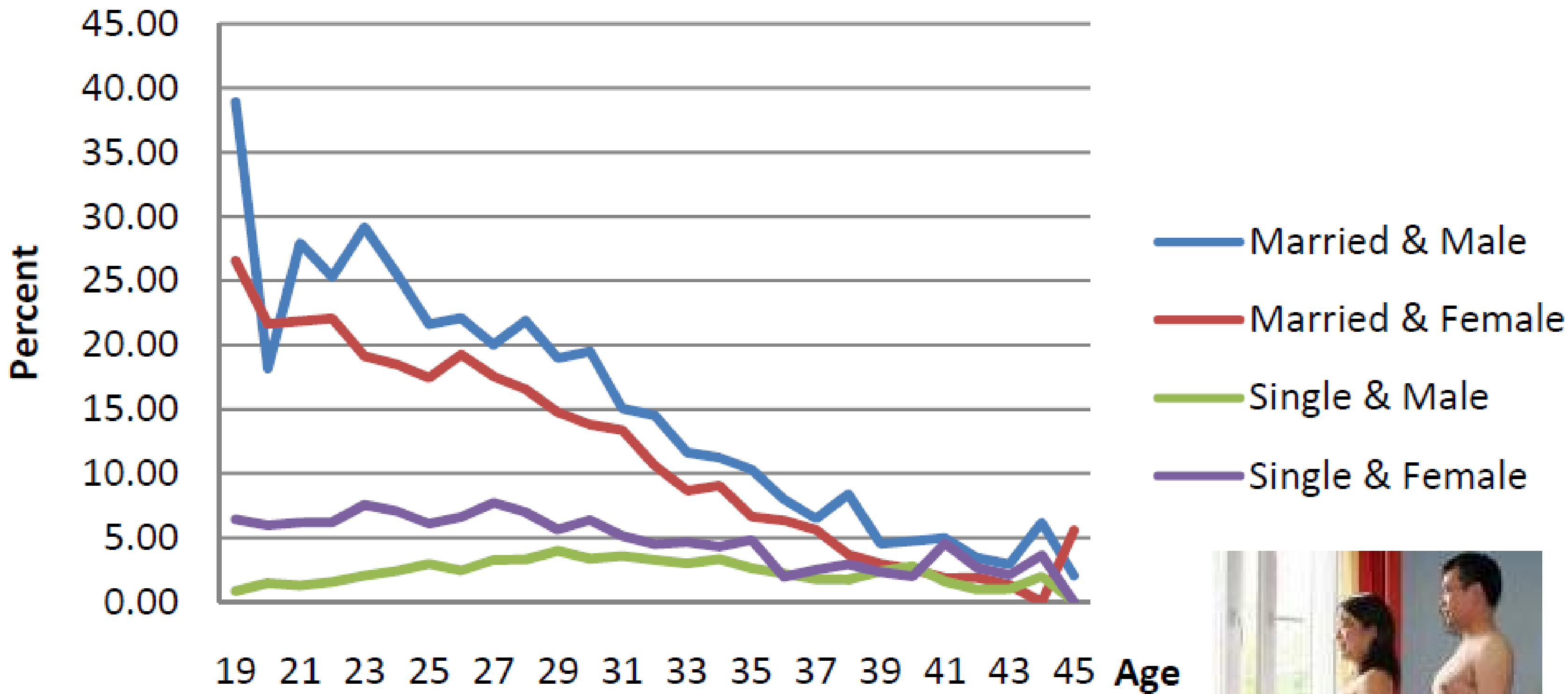


Marital Status by Age and Gender





Child Attainment
by Age, Gender, Marital Status



Body Mass Transition

$$B_{t+1} \;=\; b(B_t, C^*_{It}, C^*_{Et}, X_t, \epsilon^b_t)$$ body mass production function

$$B_{t+1} = \eta_0 + \eta_1 B_t$$

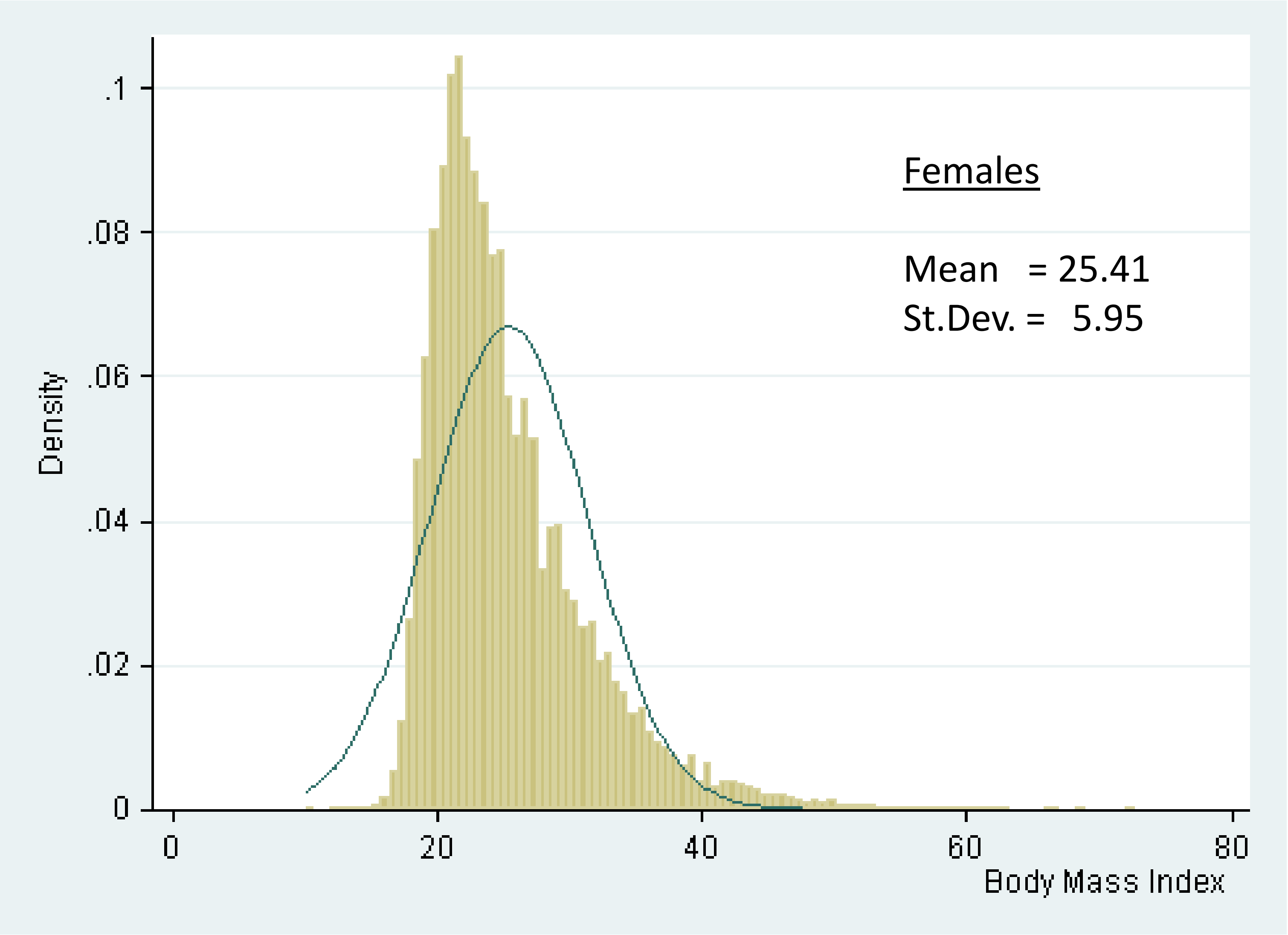
$$+ \eta_2 S_{t+1} + \eta_4 E_{t+1} + \eta_5 M_{t+1} + \eta_6 K_{t+1}$$

$$+ \eta_7 X_t + \eta_8 P^b{}_t$$

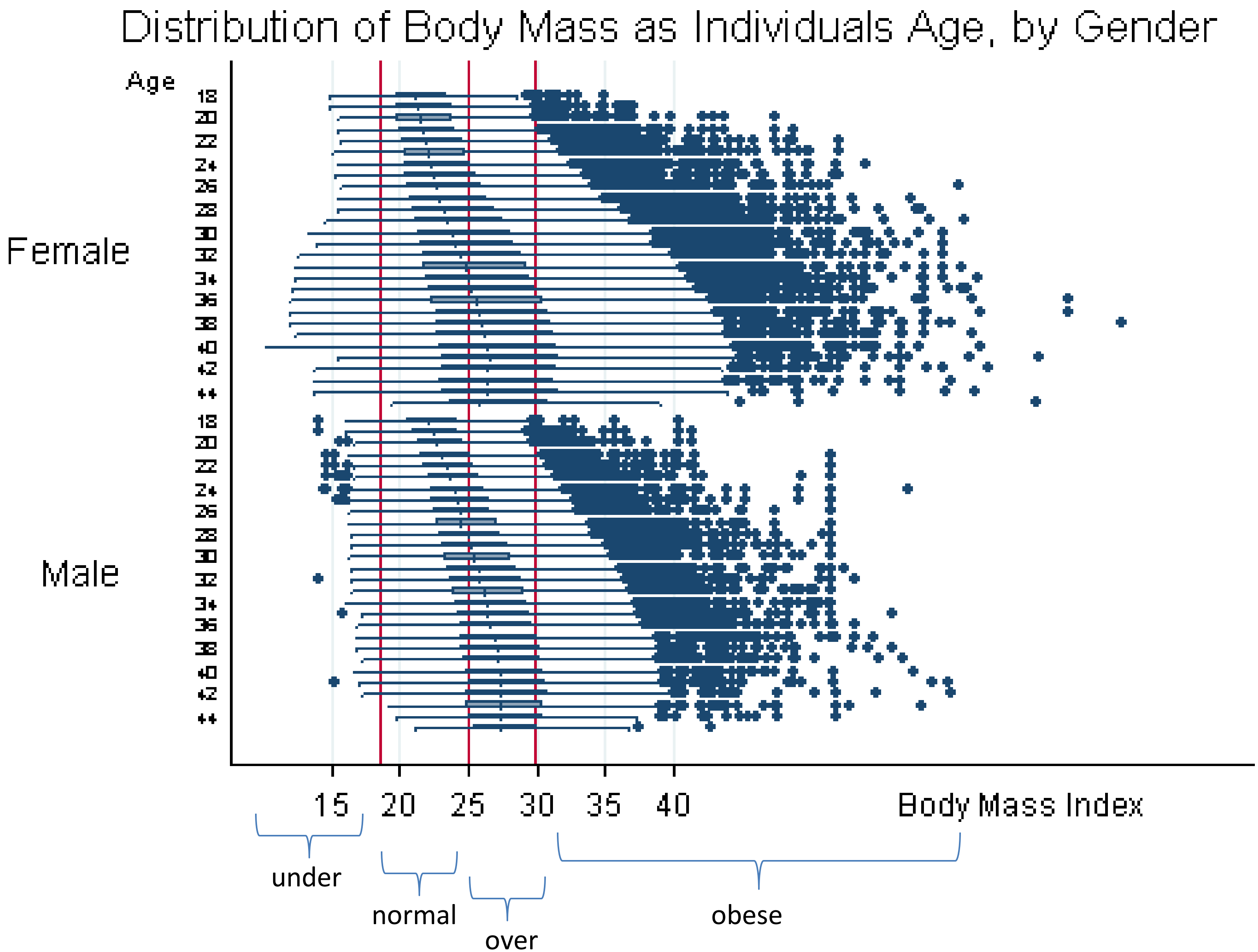
$$+ \rho^b \mu + \omega^b \nu_t + \varepsilon^b{}_t$$

	Under	Normal	Over	Obese
Female	3.95	55.75	22.77	17.53
Male	0.74	46.25	37.91	15.10

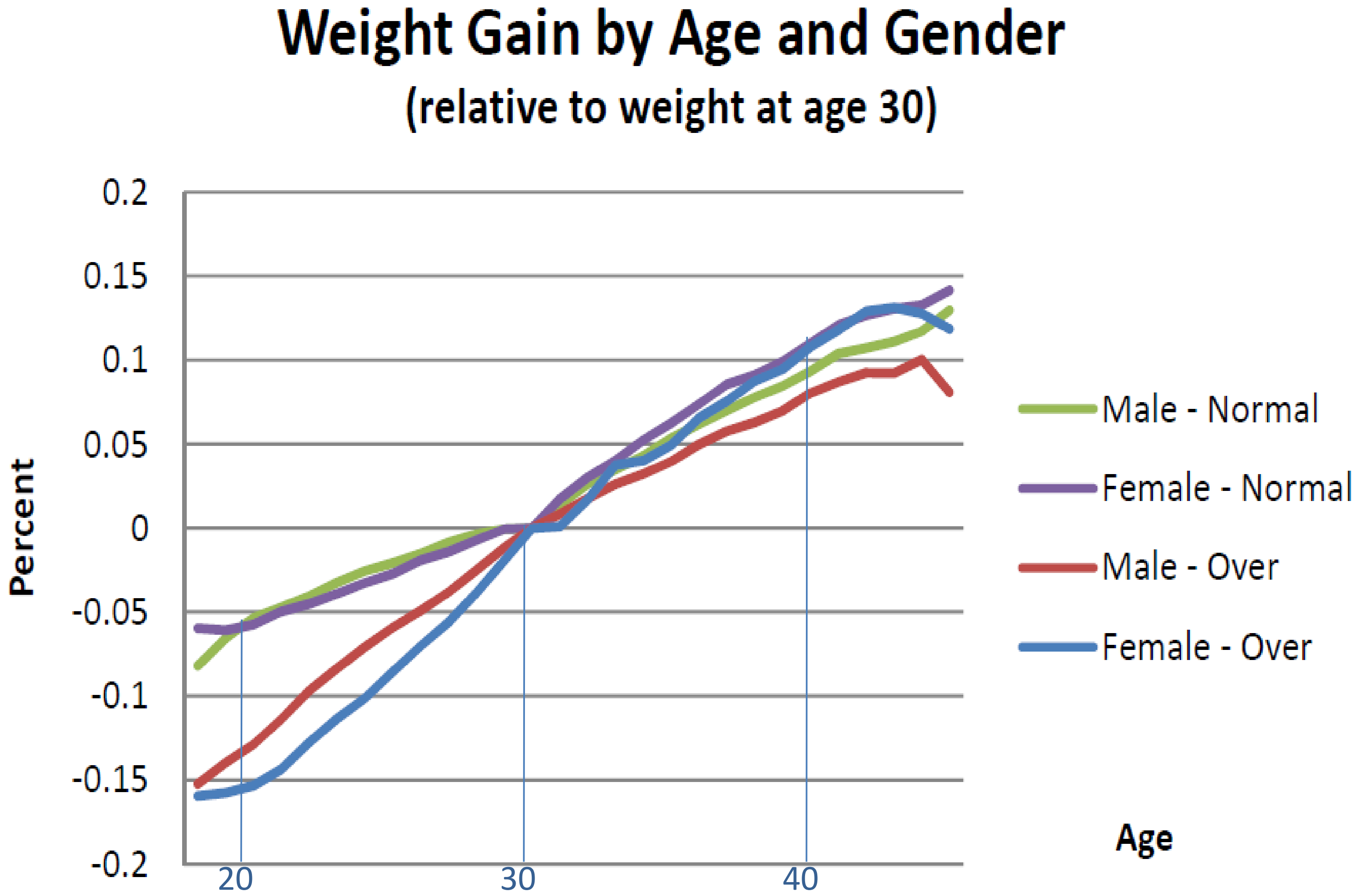
What does the distribution of body mass look like?



What does body mass look like as we age?



What does body mass look like as we age?



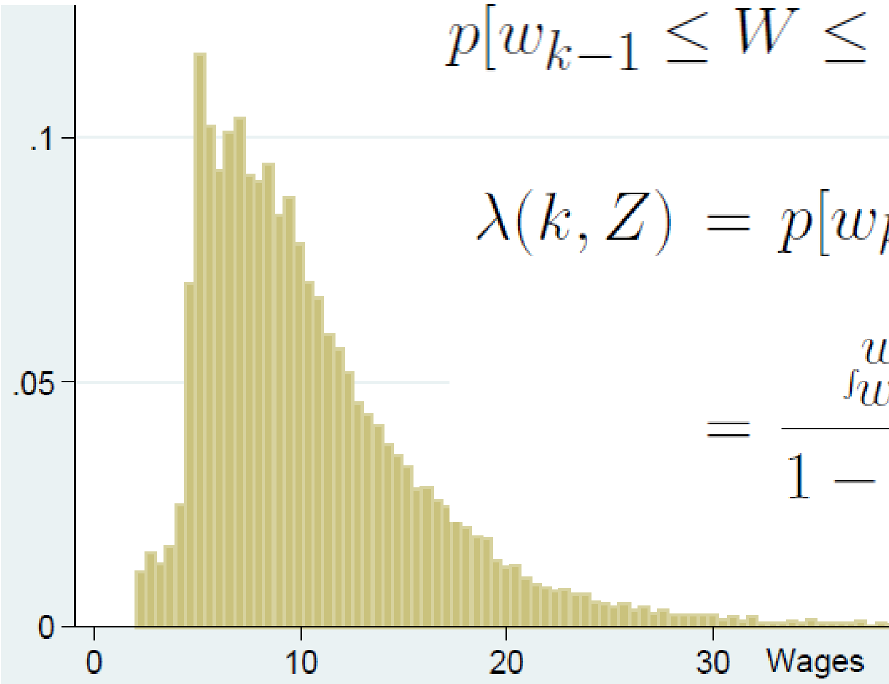
How should we estimate wages?

- OLS ? : quantifies how variation in rhs variables explain variation in the lhs variable, on average.
- It explains how the mean W varies with Z.
- In estimation, we also recover the variance of W.
- The mean and variance of W define the distribution of wages (under the assumption of a normal density).

How should we estimate wages?

- So, using OLS, we can obtain the marginal effect of Z on W, *on average*.
- But what if Z has a different effect on W at different values of W?
- Might BMI have one effect on wages at low levels of the wage and a different effect on wages at higher levels of the wage?
- How can we capture that?

Might there be a more flexible way of modeling the density?



$$p[w_{k-1} \leq W \leq w_k | Z] = \int_{w_{k-1}}^{w_k} f(w|Z)dw$$

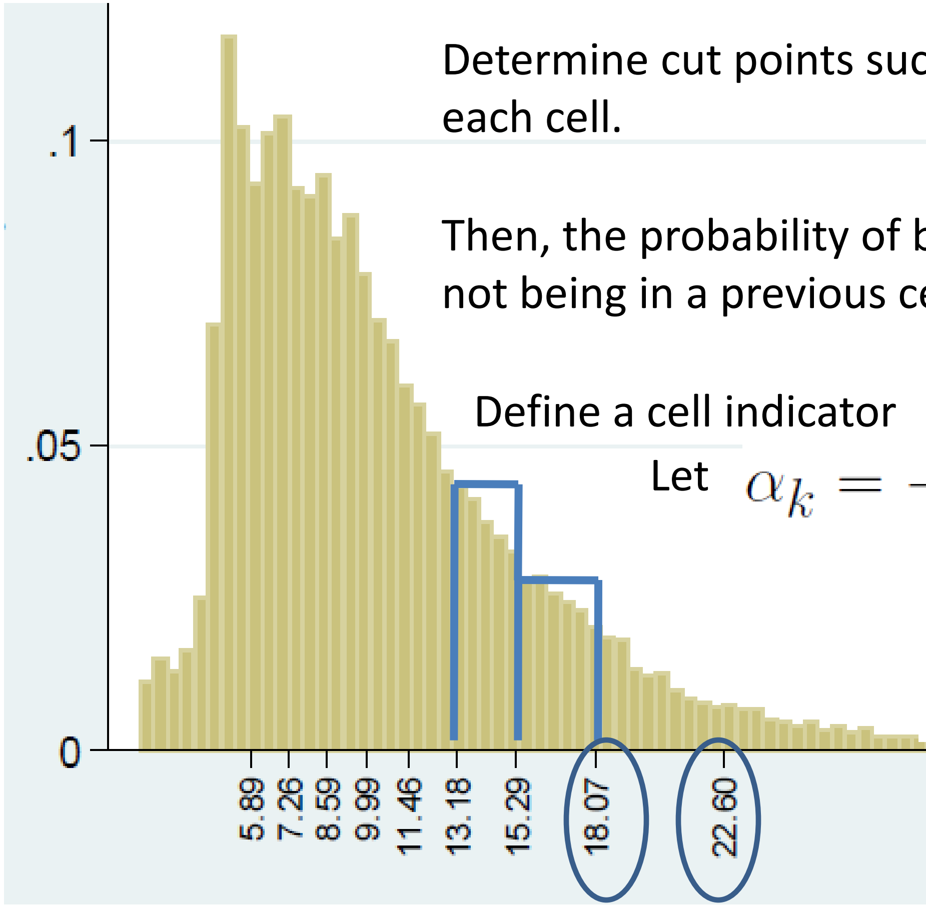
$$\lambda(k, Z) = p[w_{k-1} \leq W \leq w_k | Z, W \geq w_{k-1}]$$

$$= \frac{\int_{w_{k-1}}^{w_k} f(w|Z)dw}{1 - \int_{w_0}^{w_{k-1}} f(w|Z)dw}$$

$$p[w_{k-1} \leq W \leq w_k | Z] = \lambda(k, Z) \prod_{j=1}^{k-1} [1 - \lambda(j, Z)]$$

$$E[\mu(W)|Z] = \sum_{k=1}^{K} \varpi(k|K) \lambda(k, Z) \prod_{j=1}^{k-1} [1 - \lambda(j, Z)]$$

Conditional Density Estimation



Determine cut points such that 1/K th of individuals are in each cell.

Then, the probability of being in the kth cell , conditional on not being in a previous cell, is

$$\frac{1}{K-(k-1)}$$

Define a cell indicator

Let $\alpha_k = -\ln(K-k) \text{ for } k < K$

$$logit(\alpha_k) = \frac{e^{\alpha_k}}{1+e^{\alpha_k}}$$

Replicate each observation K times and create an indicator of which cell an individual's wage falls into.

Interact Z's with α's fully.

Estimate a logit equation (or hazard), $\lambda(k,Z)$.

$$E[\mu(W)|Z] = \sum_{k=1}^{K} \varpi(k|K)\lambda(k,Z)\prod_{j=1}^{k-1}[1-\lambda(j,Z)]$$

Replication of Literature: ln(wages) of females

Variable	Model 1	
BMI_t	**-0.008**	(0.002) ***
$BMI_t \leq 18.5$	**-0.047**	(0.024) **
$25 \leq BMI_t < 30$	**-0.022**	(0.013) *
$BMI_t \geq 30$	**-0.049**	(0.025) **
BMI_t x Black	**0.006**	(0.002) ***
BMI_t x Hisp	0.002	(0.003)
BMI_t x Asian	0.001	(0.005)
Model Includes:	X_t, B_t	

Marginal Effect of 5% ⇩	0.122	white females
	0.057	black females

Results re-transformed to levels, so changes are in cents.

Replication of Literature: ln(wages) of females

Variable	Model 1		Model 2	
BMI_t	**-0.008**	(0.002) ***	**-0.008**	(0.002) ***
$BMI_t \leq 18.5$	**-0.047**	(0.024) **	**-0.029**	(0.019)
$25 \leq BMI_t < 30$	**-0.022**	(0.013) *	-0.008	(0.012)
$BMI_t \geq 30$	**-0.049**	(0.025) **	-0.010	(0.021)
BMI_t x Black	**0.006**	(0.002) ***	**0.004**	(0.002) **
BMI_t x Hisp	0.002	(0.003)	0.001	(0.003)
BMI_t x Asian	0.001	(0.005)	0.001	(0.004)
Model Includes:	X_t, B_t		X_t, B_t, S_t, E_t, M_t, K_t	
Marginal Effect of 5% ↓	0.122 0.057		0.102 0.062	

Replication of Literature: ln(wages) of females

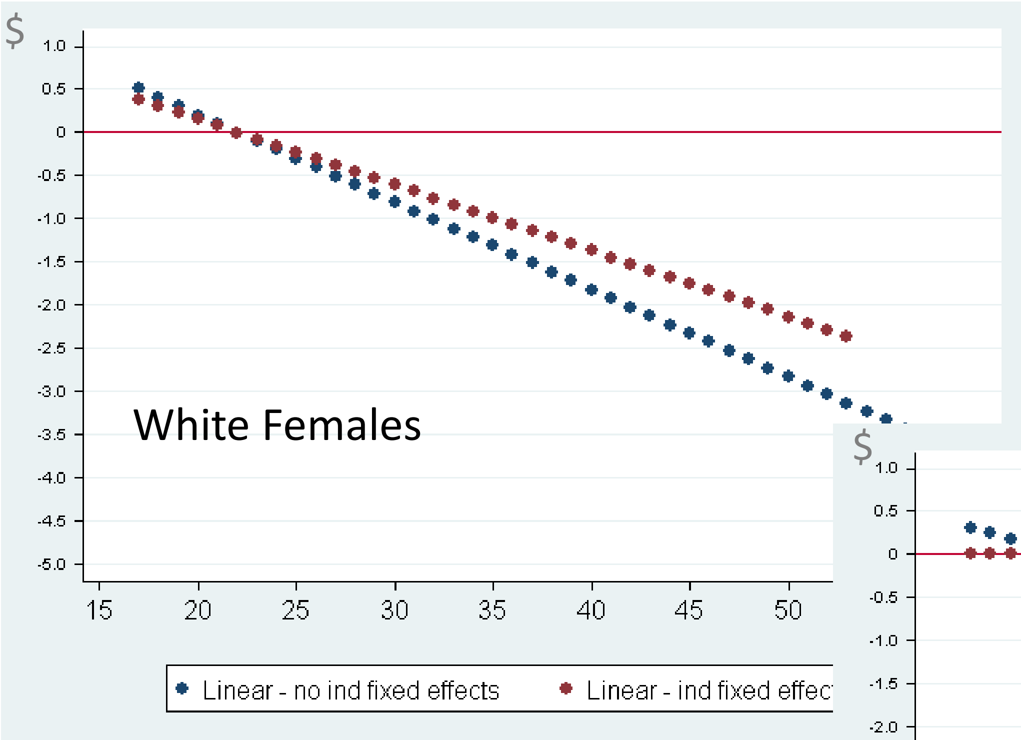
Variable	Model 1		Model 2		Model 3	
BMI_t	**-0.008**	(0.002) ***	**-0.008**	(0.002) ***	**-0.008**	(0.00 ***2)
$BMI_t \leq 18.5$	**-0.047**	(0.024) **	**-0.029**	(0.019)	**-0.028**	(0.019)
$25 \leq BMI_t < 30$	**-0.022**	(0.013) *	-0.008	(0.012)	-0.010	(0.012)
$BMI_t \geq 30$	**-0.049**	(0.025) **	-0.010	(0.021)	-0.013	(0.021)
BMI_t x Black	**0.006**	(0.002) ***	**0.004**	(0.002) **	**0.004**	(0.002) *
BMI_t x Hisp	0.002	(0.003)	0.001	(0.003)	0.000	(0.003)
BMI_t x Asian	0.001	(0.005)	0.001	(0.004)	0.002	(0.004)
Model Includes:	X_t, B_t		X_t, B_t, S_t, E_t, M_t, K_t		X_t, B_t, S_t, E_t, M_t, K_t, P^e_t	
Marginal Effect of 5%	0.122 0.057		0.102 0.062		0.099 0.063	

Replication of Literature: ln(wages) of females

Variable	Model 1		Model 2		Model 3		Model 4	
BMI_t	**-0.008**	(0.002) ***	**-0.008**	(0.002) ***	**-0.008**	(0.00 ***2)	-0.003	(0.002)
$BMI_t \leq 18.5$	**-0.047**	(0.024) **	**-0.029**	(0.019)	**-0.028**	(0.019)	**-0.046**	(0.014) ***
$25 \leq BMI_t < 30$	**-0.022**	(0.013) *	-0.008	(0.012)	-0.010	(0.012)	0.008	(0.009)
$BMI_t \geq 30$	**-0.049**	(0.025) **	-0.010	(0.021)	-0.013	(0.021)	-0.006	(0.015)
BMI_t x Black	**0.006**	(0.002) ***	**0.004**	(0.002) **	**0.004**	(0.002) *	0.004	(0.003)
BMI_t x Hisp	0.002	(0.003)	0.001	(0.003)	0.000	(0.003)	0.004	(0.003)
BMI_t x Asian	0.001	(0.005)	0.001	(0.004)	0.002	(0.004)	-0.003	(0.006)
Model Includes:	X_t, B_t		X_t, B_t, S_t, E_t, M_t, K_t		X_t, B_t, S_t, E_t, M_t, K_t, $P^e{}_t$		X_t, B_t, S_t, E_t, M_t, K_t,$P^e{}_t$, fixed effects	
Marginal Effect of 5% ⇩	0.122 0.057		0.102 0.062		0.099 0.063		0.034 -0.006	

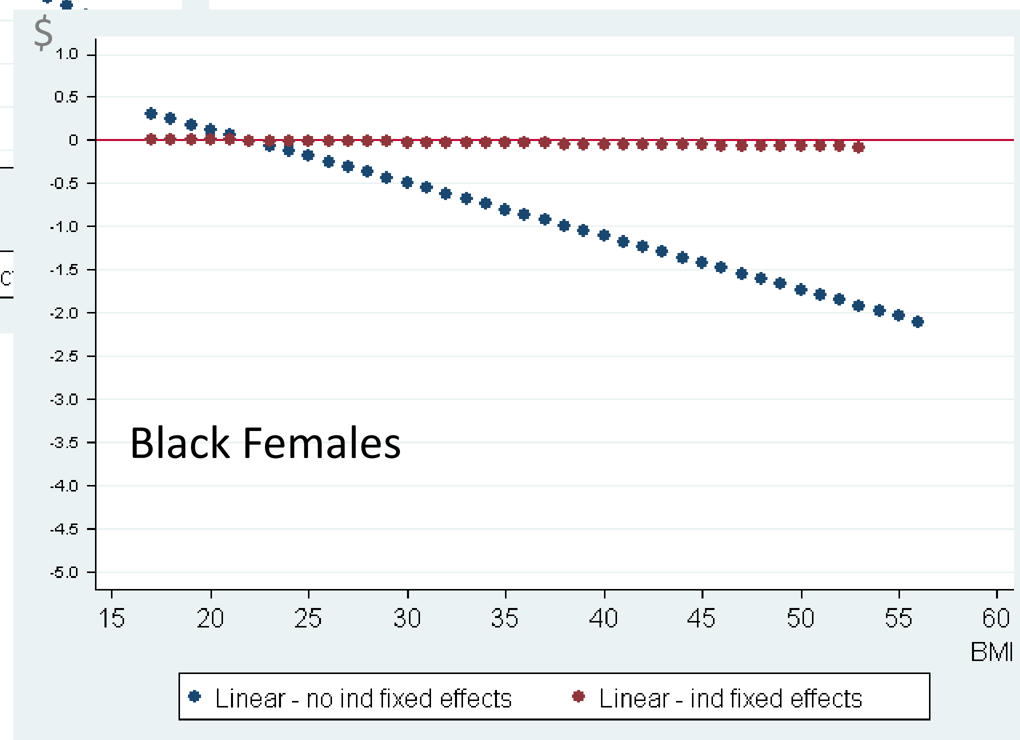
BMI Specification: Single index with fixed effects

Predicted change in wage by BMI



* Reference BMI = 22

Predicted change in wage by BMI



Source: NLSY79 data

Preliminary Results – quantile regression

Variable	25th percentile		50th percentile		75th percentile	
BMI_t	**-0.053**	(0.012) ***	**-0.071**	(0.010) ***	**-0.102**	(0.015) ***
$BMI_t \leq 18.5$	**-0.241**	(0.083) ***	**-0.232**	(0.082) ***	**-0.298**	(0.124) ***
$25 \leq BMI_t < 30$	**-0.173**	(0.085) **	-0.117	(0.083)	-0.070	(0.109)
$BMI_t \geq 30$	**-0.281**	(0.126) ***	**-0.225**	(0.110) **	0.004	(0.170)
BMI_t x Black	**0.035**	(0.008) ***	**0.044**	(0.009) ***	**0.050**	(0.013) ***
BMI_t x Hisp	**0.021**	(0.011) **	-0.001	(0.010)	-0.009	(0.018)
BMI_t x Asian	-0.007	(0.023)	0.006	(0.022)	0.061	(0.024)
Model Includes:			X_t, B_t, S_t, E_t, M_t, K_t, $P^e{}_t$			
Marginal Effect of 5% ↓	0.068 0.044		0.083 0.050		0.106 0.067	

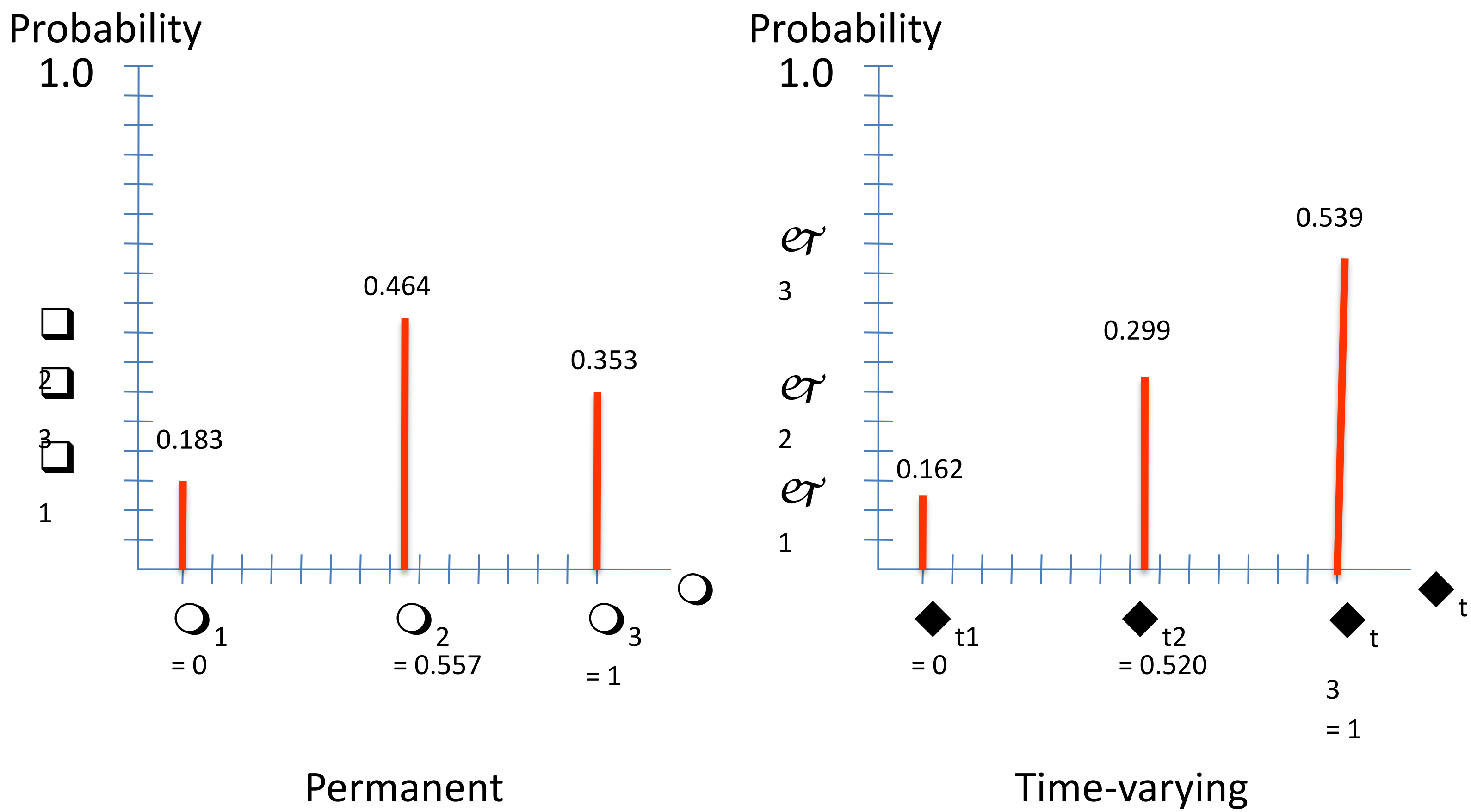
<u>CDE</u> Averages:
0.104 whites
0.064 blacks

<u>Quantile Reg</u> Averages:
0.086 whites
0.054 blacks

Fit of preferred model

Outcome	Observed Average	Predicted Probability
Enrolled	15.88	15.89
Employment		
- full time	58.48	57.59
- part time	23.09	23.14
- not employed	18.44	19.27
Married	52.80	52.83
Children		
- no change	88.96	88.99
- acquire	8.06	8.61
- lose	2.44	2.40
BMI	25.68	25.64
Wage	10.71	10.32

Preliminary Results: preferred model
Unobserved Heterogeneity Distribution



Simulated reduction in weight

Age	Predicted Wage By Age		Predicted Difference if BMI reduced 5%			Age	Predicted Wage By Age		Predicted Difference if BMI reduced 5%	
	White	Black	White	Black			White	Black	White	Black
19	6.38	5.84	0.000	-0.030		33	11.87	10.34	0.028	-0.006
20	6.78	5.97	-0.001	-0.032		34	12.09	10.59	0.028	-0.001
21	7.17	6.37	0.001	-0.035		35	12.15	10.83	0.036	-0.005
22	7.87	6.95	0.002	-0.034		36	12.64	11.02	0.036	0.011
23	8.59	7.47	0.005	-0.033		37	12.80	11.46	0.045	0.009
24	9.18	7.88	0.004	-0.035		38	13.14	11.78	0.043	0.018
25	9.65	8.25	0.008	-0.034		39	13.09	11.79	0.036	0.019
26	10.07	8.55	0.010	-0.033		40	13.69	12.39	0.045	0.024
27	10.45	8.91	0.012	-0.030		41	13.83	12.67	0.036	0.024
28	10.80	9.19	0.015	-0.025		42	14.17	12.95	0.051	0.020
29	11.14	9.45	0.018	-0.020		43	14.28	13.40	0.033	0.044
30	11.34	9.78	0.019	-0.019		44	14.17	14.03	0.050	0.016
31	11.58	10.09	0.021	-0.017		45	15.11	13.53	0.015	0.067
32	11.83	10.13	0.023	-0.005		Ave	10.96	9.57	0.020	-0.015

Preliminary Results: using preferred model

- No updating: simply compute the effect of a change in BMI given the values of one's observed RHS variables entering the period.
- Hence, this calculation provides only the direct effect of BMI on wages.
- We find that a 5% decrease in BMI leads to a small increase in wages for white females and a slight decrease in wages of black females.
- This simulation does not update state variables over time; hence no change in behaviors associated with the reduction in BMI.

Sources of differences from preliminary models

- *Specification* of BMI (more moments, interactions)
- *Selection* into employment
- *Endogenous* BMI
- *Endogenous* state variables (related to history of schooling, employment, marriage, and children)
- *Random* effects vs fixed effects
- Permanent and *time-varying* heterogeneity
- Modeling of effect of BMI on *density* of wages

Preliminary Conclusions

- Permanent and time-varying *unobservables* that influence BMI also affect wages (and therefore must be accounted for)
- In addition to its direct effect on wages, BMI has a significant effect on wages through particular *endogenous channels*: schooling, work experience, marital status, and number of children.
- Conditional density estimation results suggest that it is important to model the effect of BMI across the *distribution* of wages, not just the mean. (And to model the different effects of past decisions across the distribution of current BMI.)
- BMI appears to have only a very small statistically significant *direct* effect on women's wages (an effect that remains unexplained).

Additional Feedback …

- The body mass index (BMI) specifies a particular relationship b/w weight and height
- In light of the positive height effect and conjectured “beauty” effect on wages, are the appropriate measures simply weight and height?
- How might we simulate a change in BMI or weight when updating?

Thank you!

- I look forward to further discussion.

- Please email me with any comments, questions, or suggestions:

donna_gilleskie@unc.edu