What can we learn about the effects of food stamps on obesity in the presence of misreporting?

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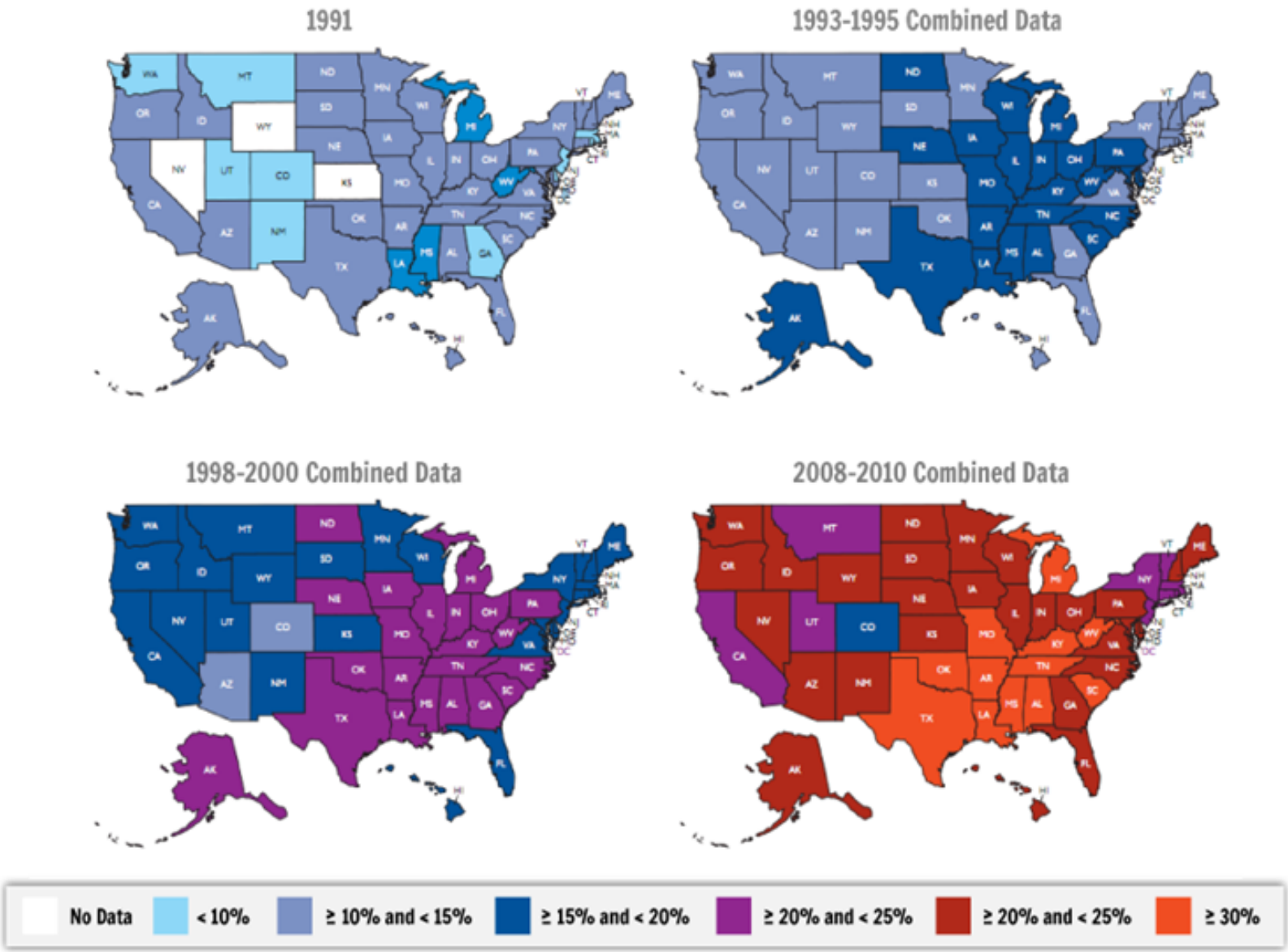
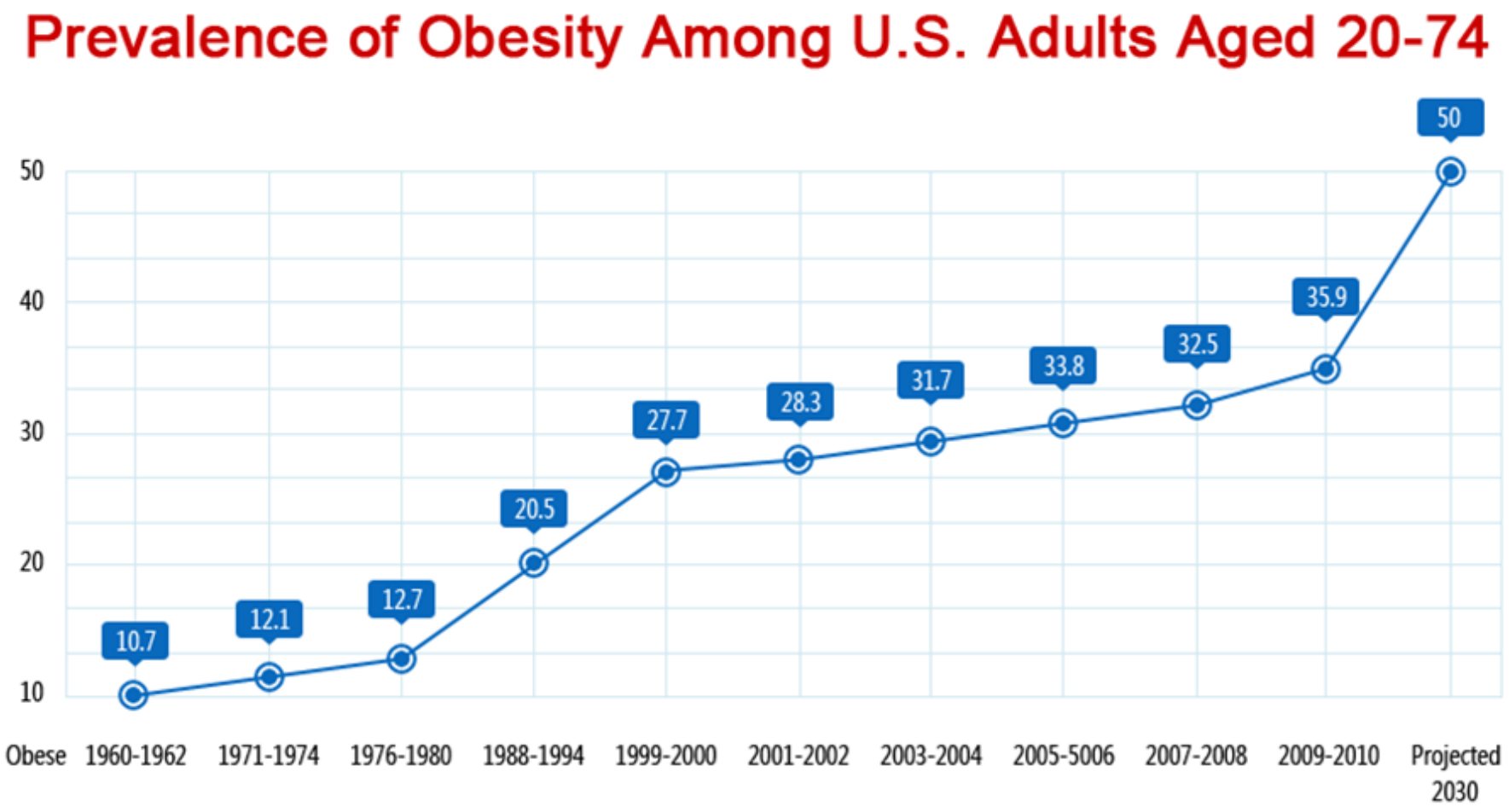
Background

- Substantial increase in obesity in recent decades, currently over 20% of adults in every state and 35% in some states (Ogden *et al.* , 2014)
- Negative effects from obesity on personal health, healthcare expenditures, and wage growth are well documented (Rosin, 2008; Bhattacharya & Bundorf, 2009; Finkelstein *et al.* , 2009; Cawley & Meyerhoefer, 2012)
- Much higher obesity rates among lower income households (Rosin, 2008)

Obesity Maps

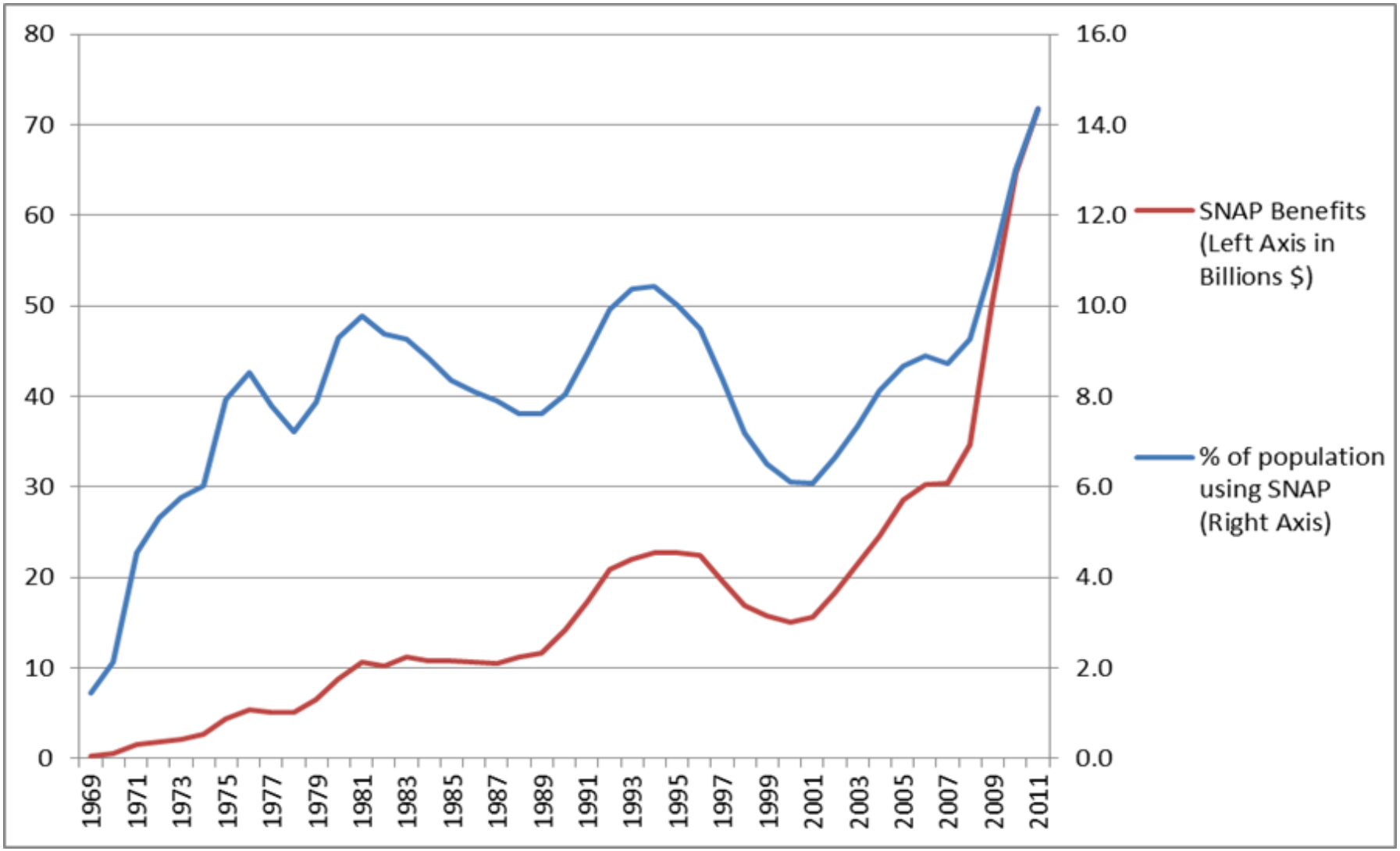


Obesity Trend



Derived from NHANES data

SNAP Trend


80
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SNAP Benefits (Left Axis in Billions $)
% of population using SNAP (Right Axis)

Role of SNAP

- Supplemental Nutrition Assistance Program (SNAP) is the largest federal nutrition assistance program in the US
- Increase in expenditures from $23 billion in 2000 (17.2 million recipients) to $74 billion in 2014 (46.5 million recipients)
- Large body of literature documents positive relationship between SNAP and obesity (Townsend *et al.* , 2001; Gibson, 2003; Chen *et al.* , 2005; Kaushal, 2007; Ver Ploeg & Ralston, 2008; Meyerhoefer & Pylypchuk, 2008; Baum, 2011)
- Almada and Tchernis (2015) show negative effects of SNAP on adult obesity at the intensive margin of SNAP benefit available per adult

Empirical Problem

1. In addition to self-selection, SNAP participation is heavily mismeasured in self-reported survey data (Bollinger & David, 1997; Meyer *et al.* , 2009; Vassilopoulos *et al.* , 2011; Kreider *et al.* , 2012)
2. Are findings of a positive effect of SNAP on adult obesity robust to both self-selection and misreported participation?

Is misreporting a problem?

1. Meyer, Mok, and Sullivan (2009) document substantial levels of under-reporting of program participation in survey data compared to administrative data
2. Lewbel (2007) shows that if misreporting is random and participation is exogenous it results in attenuation bias
3. Nguimkeu, Denteh, and Tchernis (2015) model endogenous misreporting, show possible sign reversal of OLS and Lewbel's estimator, expansion bias of IV, and develop a consistent estimators

Current Study

Revisit role of SNAP on adult obesity with several alternative estimators

1. IV-based point estimates
2. Point estimates with parametric misreporting
3. Nonparametric bounds

What is SNAP?

- Largest federal nutrition assistance program
- Eligibility based on gross income $<$ 130% of FPL, along with TANF or SSI recipients
- Benefits distributed differently across states
- Mandated EBT cards nationally in 2002

Food Stamp Cycle

- Participants exhaust benefits before end of month (80% have no funds left on EBT after two weeks)
- Periods of undereating and potential overeating
- Weight gain for both children and adults
- Some evidence of this in SNAP (Wilde & Ranney, 2000; Hastings & Washington, 2010)

Types of Foods Purchased

- Poor health effects if SNAP participants purchase more but unhealthy foods
- Positive health effects if SNAP participants purchase healthier (more expensive) foods

→ Ambiguous effect on obesity

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In-kind Nature of SNAP Benefits

- If surplus, participants must spend more on food or have benefits go unused
- Some evidence that SNAP participants spent more on food than with equivalent cash transfer (Devaney & Moffitt, 1991; Fraker *et al.* , 1995)

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Empirical Evidence

- Ultimately an empirical question
- Large nutrition and public health literature showing positive effect
- Taking selection into SNAP more seriously, economics literature still finds positive effect for women (Gibson, 2003; Meyerhoefer & Pylypchuk, 2008; Baum, 2011)
- Policy briefs describe positive effect of SNAP on obesity for adult women (Ver Ploeg & Ralston, 2008)

Self-reported SNAP Participation

- 12% under-reporting at the household level (Bollinger & David, 1997)
- 22% under-reporting at the individual level (Marquis & Moore, 2010)
- Increasing under-reporting over time in the CPS, from 21% in 1991 to 36% in 1999 (Cody & Tuttle, 2002)
- 35% under-reporting in 2001 ACS, 50% in the 2002-2005 CPS (Meyer *et al.* , 2011)

Available Methods for Misreporting

- Mahajan (2006) and Lewbel (2007) achieve point identification of ATE with "instrument-like" variable that is correlated with the true treatment status but conditionally independent of measurement error
- Frazis & Loewenstein (2003) develop moment estimator, but under-identified with both endogenous and misreported treatment
- Brachet (2008), following Hausman *et al.* (1998), proposes two-stage estimator with parametric misreporting specification
- Nonparametric bounds (Manski & Pepper, 2000; Kreider & Pepper, 2007; Kreider *et al.* , 2012; Gundersen *et al.* , 2012)

Data Sources

- National Longitudinal Survey of Youth - 1979 Cohort (NLSY79) for 1996 - 2004
- State level SNAP policies from Food Stamp Program Rules Database

NLSY-79

- SNAP participation in past year (self-reported)
- Estimated SNAP eligibility (based on FPL thresholds using income and household size)
- BMI from self-reported height (in 1985 or 1982) and weight
- Other demographics including number of children, age, race, gender, marital status, employment, and education

State SNAP Policies

- Biometric identification technology (fingerprint scanning)
- % of benefits issued by direct mail

SNAP Eligibility

- Formally restricted to 130% of FPL
- Households may be temporarily eligible during the year despite annual incomes $>$ 130% of FPL
- Focus on 250% of FPL (consider 130% and 185%)

Parametric Estimators

- Fixed Effects
- Fixed Effects IV
- Misreporting-adjusted Fixed Effects

Misreporting

Denote true treatment status by $T_i^* = 1\left(z_i\delta + \nu_i > 0\right)$, and observed treatment status by T_i. Then misreporting probabilities are denoted

$$\alpha_0 \equiv \Pr\left(T_i = 1 | T_i^* = 0\right)$$
$$\alpha_1 \equiv \Pr\left(T_i = 0 | T_i^* = 1\right).$$

Misreporting-adjusted Fixed Effects

1. Estimate misreporting probabilities using NLS, including state IVs (Hausman *et al.* , 1998):
$$\frac{1}{N}\sum_{i=1}^{N}\left\{T_i - \alpha_0 - (1-\alpha_0-\alpha_1)F_\nu(z_i\delta)\right\}^2,$$
where $F_\nu(\cdot)$ is the cumulative distribution function (CDF) of ν_i.
2. Form the predicted true treatment status, $\hat{P}_{it} = F_\nu(z_{it}\hat{\delta}_t)$, for each year.
3. Estimate a standard linear fixed effects model, $y_{it} = \gamma\hat{P}_{it} + x_{it}\beta + \phi_i + \varepsilon_{it}$.

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Non-parametric Bounds

- Produce bounds on the magnitude of the treatment effects under variety of assumptions about the nature of selection and misreporting
- Monotone treatment selection:
  $P[Y(t) = 1|D^* = 0] \leq P[Y(t) = 1|D^* = 1], t \in \{0, 1\}$
- Monotone instrumental variable: for $u_1 > u > u_2$,
  $P[Y(t) = 1|\nu = u_1] \leq P[Y(t) = 1|\nu = u] \leq P[Y(t) = 1|\nu = u_2]$

Misreporting

Year(s)		Full Sample	Females	Males
All Years	$\hat{\alpha}_0$	0.043***	0.064***	0.056***
	$\hat{\alpha}_1$	0.289***	0.397***	0.696***
1996	$\hat{\alpha}_0$	0.072***	0.108***	0.079**
	$\hat{\alpha}_1$	0.389***	0.312***	0.568**
1998	$\hat{\alpha}_0$	0.036***	0.045***	0.042**
	$\hat{\alpha}_1$	0.351***	0.439***	0.667***
2000	$\hat{\alpha}_0$	0.033	0.055**	0.038**
	$\hat{\alpha}_1$	0.240	0.454***	0.657**
2002	$\hat{\alpha}_0$	0.052**	0.098***	0.041*
	$\hat{\alpha}_1$	0.225	0.429***	0.719***
2004	$\hat{\alpha}_0$	0.064***	0.090***	0.077***
	$\hat{\alpha}_1$	0.447***	0.465***	0.577***

Point Estimates for P(Obese)

	FE-IV			
FE	Biometric	Direct Mail	Both IVs	MA-FE
Full Sample, $N = 12,015$				
0.020**	0.142	-0.221	0.001	0.008
(0.010)	(0.212)	(0.280)	(0.170)	(0.017)
Females, $N = 6,832$				
0.004	0.188	-0.203	0.070	-0.005
(0.012)	(0.194)	(0.289)	(0.162)	(0.017)
Males, $N = 5,183$				
0.054***	-0.089	-0.299	-0.210	0.004
(0.016)	(0.693)	(0.689)	(0.510)	(0.024)

Point Estimates for P(Overweight)

	FE-IV			
FE	Biometric	Direct Mail	Both IVs	MA-FE
Full Sample, $N = 12,015$				
-0.006	0.410*	0.188	0.324*	-0.035*
(0.010)	(0.245)	(0.286)	(0.196)	(0.019)
Females, $N = 6,832$				
-0.005	0.301	0.164	0.259	-0.003
(0.012)	(0.206)	(0.302)	(0.181)	(0.017)
Males, $N = 5,183$				
-0.004	0.838	0.263	0.507	-0.020
(0.017)	(1.009)	(0.676)	(0.588)	(0.022)

Bounds for P(Obese)

Error Rates	Arbitrary Misreporting		No False Positives	
Exogenous Selection				
0	[0.063,	0.063]	[0.063,	0.063]
.05	[-0.169,	0.226]	[-0.034,	0.226]
.1	[-0.397,	0.459]	[-0.111,	0.358]
Worst-case Selection				
0	[-0.386,	0.614]	[-0.386,	0.614]
.05	[-0.436,	0.664]	[-0.436,	0.664]
.1	[-0.486,	0.714]	[-0.486,	0.714]
Negative Monotone Treatment Selection (MTSn)				
0	[-0.386,	0.063]	[-0.386,	0.063]
.05	[-0.436,	0.226]	[-0.436,	0.226]
.1	[-0.486,	0.459]	[-0.486,	0.358]
Monotone Instrumental Variable with MTSn				
0	[-0.276,	-0.016]	[-0.276,	-0.016]
.05	[-0.368,	0.128]	[-0.326,	0.142]
.1	[-0.442,	0.225]	[-0.376,	0.235]

Bounds for P(Overweight)

Error Rates	Arbitrary Misreporting		No False Positives	
Exogenous Selection				
0	[0.008,	0.008]	[0.008,	0.008]
.05	[-0.173,	0.268]	[-0.173,	0.088]
.1	[-0.317,	0.381]	[-0.317,	0.152]
Worst-case Selection				
0	[-0.607,	0.393]	[-0.607,	0.393]
.05	[-0.657,	0.443]	[-0.657,	0.443]
.1	[-0.707,	0.493]	[-0.707,	0.493]
Negative Monotone Treatment Selection (MTSn)				
0	[-0.607,	0.008]	[-0.607,	0.008]
.05	[-0.657,	0.268]	[-0.657,	0.088]
.1	[-0.707,	0.381]	[-0.707,	0.152]
Monotone Instrumental Variable with MTSn				
0	[-0.531,	-0.070]	[-0.531,	-0.070]
.05	[-0.631,	0.105]	[-0.581,	0.030]
.1	[-0.707,	0.222]	[-0.631,	0.078]

Summary of Estimated Effects

FE	FE-IV	MA-FE	MTSn	MIV-MTSn
		Obese - Full Sample		
0.020**	0.001	0.008	[-0.486, 0.358]	[-0.376, 0.235]
(0.010)	(0.170)	(0.017)		
		Obese - Females		
0.004	0.070	-0.005	[-0.628, 0.531]	[-0.536, 0.339]
(0.012)	(0.162)	(0.017)		
		Obese - Males		
0.054***	-0.210	0.004	[-0.630, 0.769]	[-0.553, 0.643]
(0.016)	(0.510)	(0.024)		
		Overweight - Full Sample		
-0.006	0.324*	-0.035*	[-0.707, 0.152]	[-0.631, 0.078]
(0.010)	(0.196)	(0.019)		
		Overweight - Females		
-0.005	0.259	-0.003	[-0.766, 0.292]	[-0.691, 0.173]
(0.012)	(0.181)	(0.017)		
		Overweight - Males		
-0.004	0.507	-0.020	[-0.911, 0.343]	[-0.879, 0.251]
(0.017)	(0.588)	(0.022)		

Sensitivity

- Alternative dataset with persistent eligibility and balanced panel (Baum, 2011)
- BMI adjustment Cawley (2004)
- Alternative eligibility criteria

Takeaways

1. Evidence of high rates of misreporting in SNAP, variable over time and across gender
2. Usual IV approach problematic
3. No adjustments or only misreporting adjustment appear better than IV adjustment
4. Findings of positive effect of SNAP on obesity among women do not persist in presence of misreporting
5. Work in Progress: Nguimkeu, Denteh and Tchernis (2015) endogenous misreporting estimator.

Simulation Results from NDT

False Negatives	φ_u	Estimator				
		OLS (True)	OLS (Obs.)	IV	Adj-IV	NDT
5%	0.0	-0.1995	-0.1891	-0.2103	-0.1999	-0.2008
	0.3	-0.2008	-0.1255	-0.2112	-0.2007	-0.2006
	0.6	-0.1993	-0.0587	-0.2102	-0.1998	-0.1999
	0.9	-0.1992	0.0053	-0.2098	-0.1994	-0.2002
10%	0.0	-0.1990	-0.1782	-0.2224	-0.1989	-0.2028
	0.3	-0.2008	-0.0629	-0.2251	-0.2012	-0.2018
	0.6	-0.2014	0.0518	-0.2261	-0.2022	-0.2040
	0.9	-0.2004	0.1684	-0.2240	-0.2004	-0.2012
20%	0.0	-0.1990	-0.1630	-0.2472	-0.1983	-0.2020
	0.3	-0.2003	0.0172	-0.2508	-0.2012	-0.2023
	0.6	-0.1999	0.1979	-0.2492	-0.2000	-0.2048
	0.9	-0.2000	0.3773	-0.2489	-0.1997	-0.2015
40%	0.0	-0.2005	-0.1378	-0.3340	-0.1999	-0.2064
	0.3	-0.2003	0.1464	-0.3372	-0.2018	-0.2066
	0.6	-0.2008	0.4281	-0.3352	-0.2007	-0.2060
	0.9	-0.2009	0.7116	-0.3386	-0.2027	-0.2050

Thank You

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