Egalitarian Vehicles? Distributional Effects of Electric Vehicle Driving and Purchase Subsidies

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Electric Cars

- Examples: Tesla Model S and Nissan Leaf
- $7500 federal purchase subsidy
- 8 states offer purchase subsidies in 2014
  - California ($2500), Colorado ($6000), Georgia ($5000), Illinois ($4000), Maryland ($3000), Mass. ($2500), Texas ($2500) & Utah ($1500)

This Paper

- Distributional effects of electric car adoption
  - Damages from fleet of electric cars
  - Damages from fleet of substitute gasoline cars
  - Environmental benefits
  - Pecuniary benefits of subsidies

Data and Methods

- Electric car registrations from IHS Automotive (June 2014)
- Demographic data from US Census (income, race, population) Data
- Damage matrices for gas and electric cars as an extension of Holland et al., (2016)
  - $g_{i,j}$ damages per mile in county j due to driving gas car in county i
- Calculate distribution of damages received by a given county (equity) and created by a given county (efficiency)
  - Fleet of cars, each driven 15,000 miles per year

Holland et al., (2016) Damage Calculations

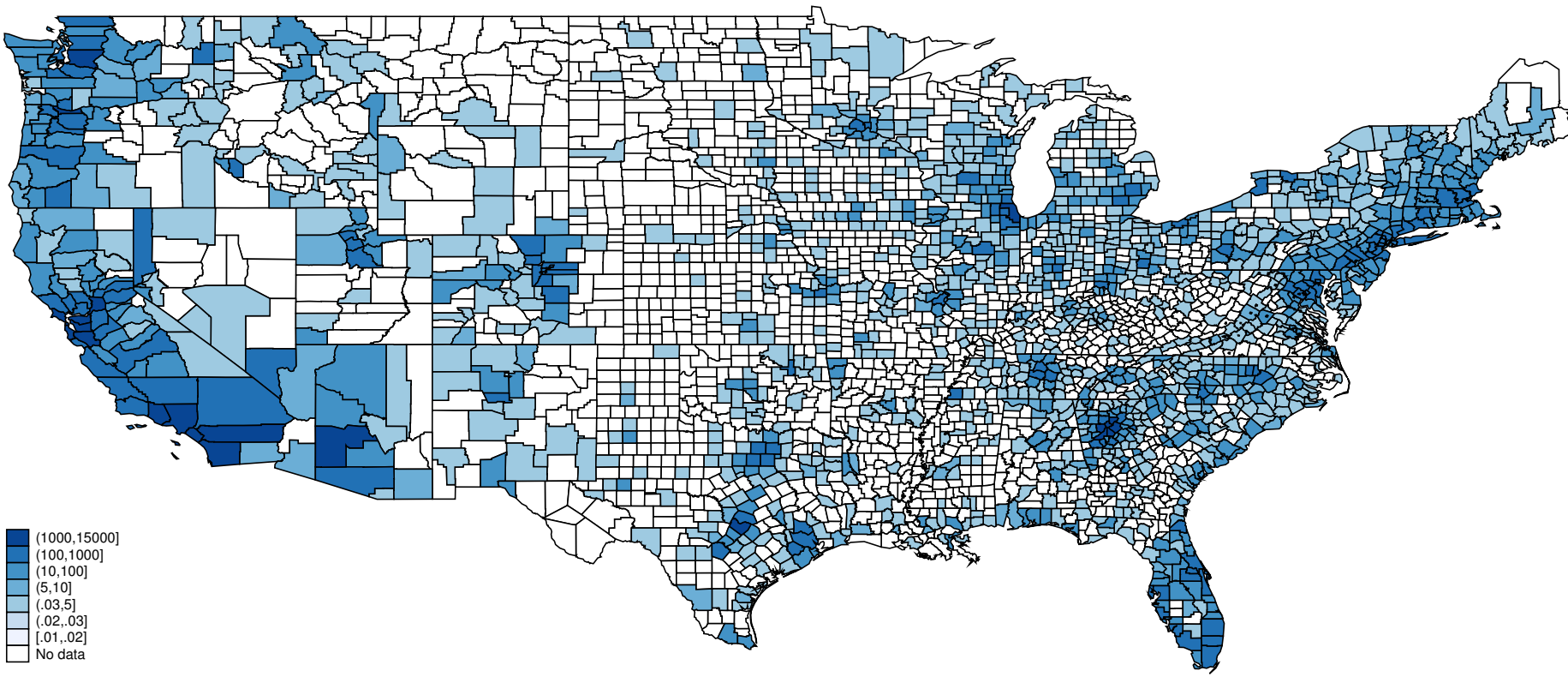
- Gasoline Cars
  - Emissions from tailpipes (EPA, GREET)
  - AP 2 model for transport and valuation
- Electric Cars
  - NERC regions
  - Regressions: marginal effect of load on emissions
  - kWh/mile (EPA)
  - Temperature correction
  - AP 2 model for transport and valuation

IHS Data: What cars?

Electric and Substitute Gas Cars

Electric	Substitute	Registrations
Chevy Spark	Chevy Spark	1,899
Fiat 500	Fiat 500	8,555
Ford Focus	Ford Focus	4,436
Honda Fit	Honda Fit	1,055
Mitsubishi i-Miev	Chevy Spark	1,721
Nissan Leaf	Toyota Prius	69,860
Smart EV	Smart	4,077
Tesla S	BMW 750	38,235
Toyota Rav4	Toyota Rav4	2,456
Total		132,294

IHS Data: Where are the Cars?

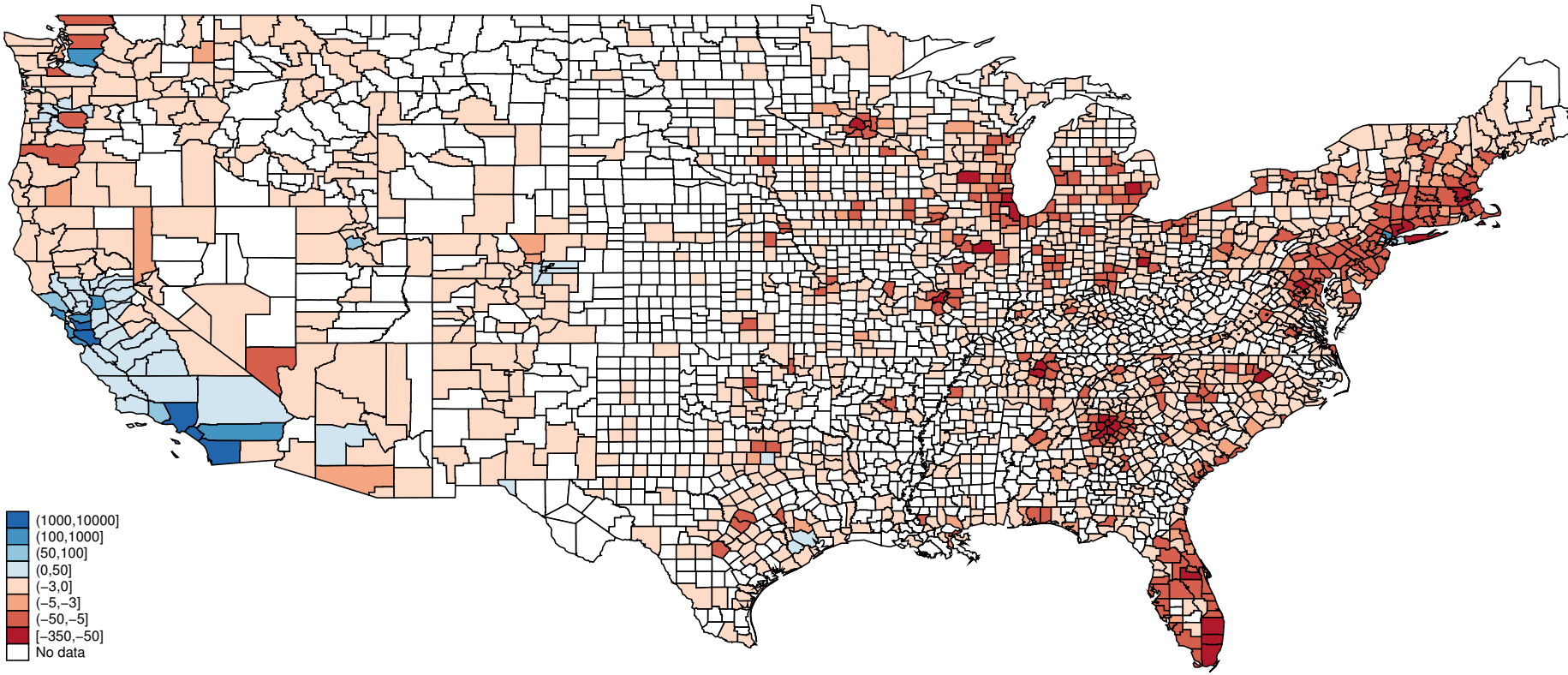


IHS Data: Where are the Cars?

- 98% in urban areas

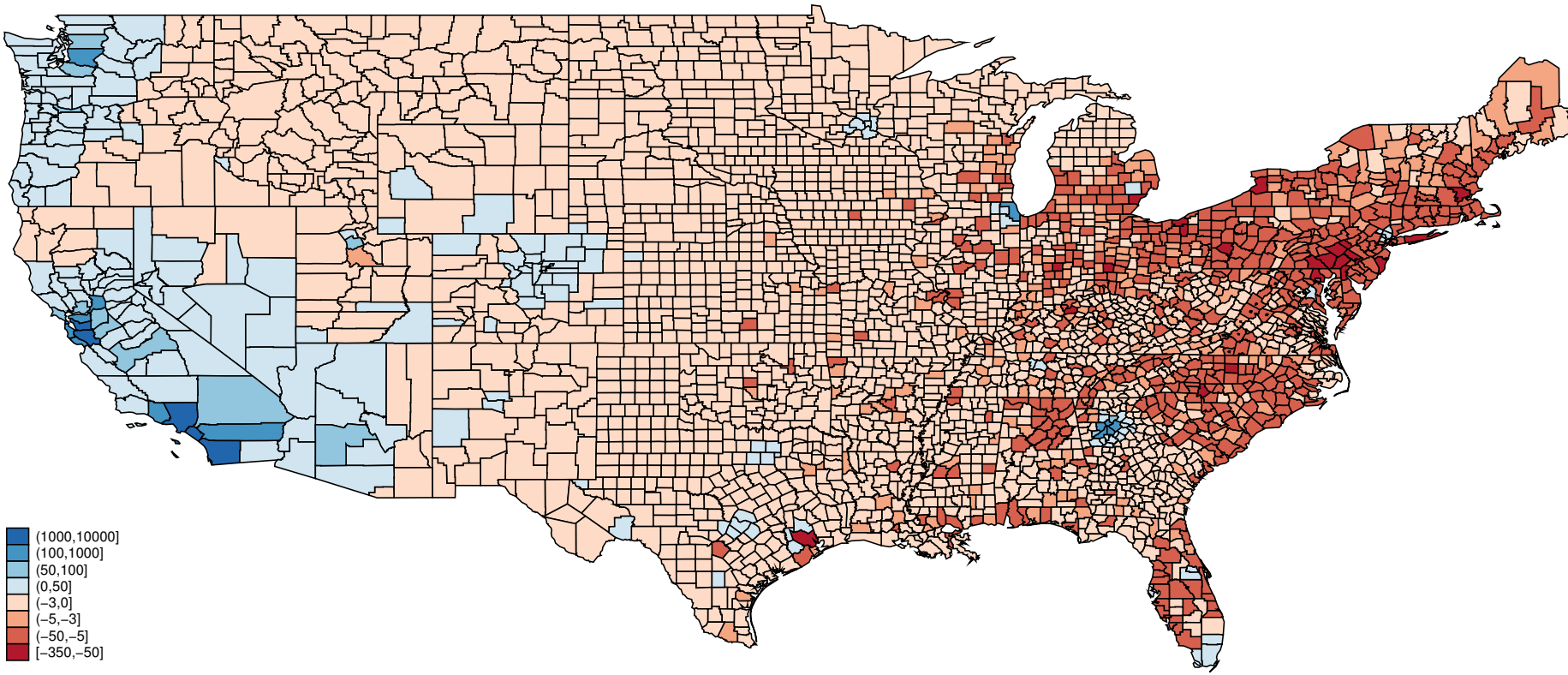
City (MSA)	Number of Vehicles
Atlanta, GA	14,496
Los Angeles, CA	13,854
San Jose, CA	11,170
Oakland, CA	8,131
San Francisco, CA	6,437
Seattle, WA	6,352
Santa Ana, CA	5,734
San Diego, CA	5,722
Portland, OR-WA	3,105
Sacramento, CA	2,838

Results: Environmental Benefits Created by County ($1,000)



More Maps

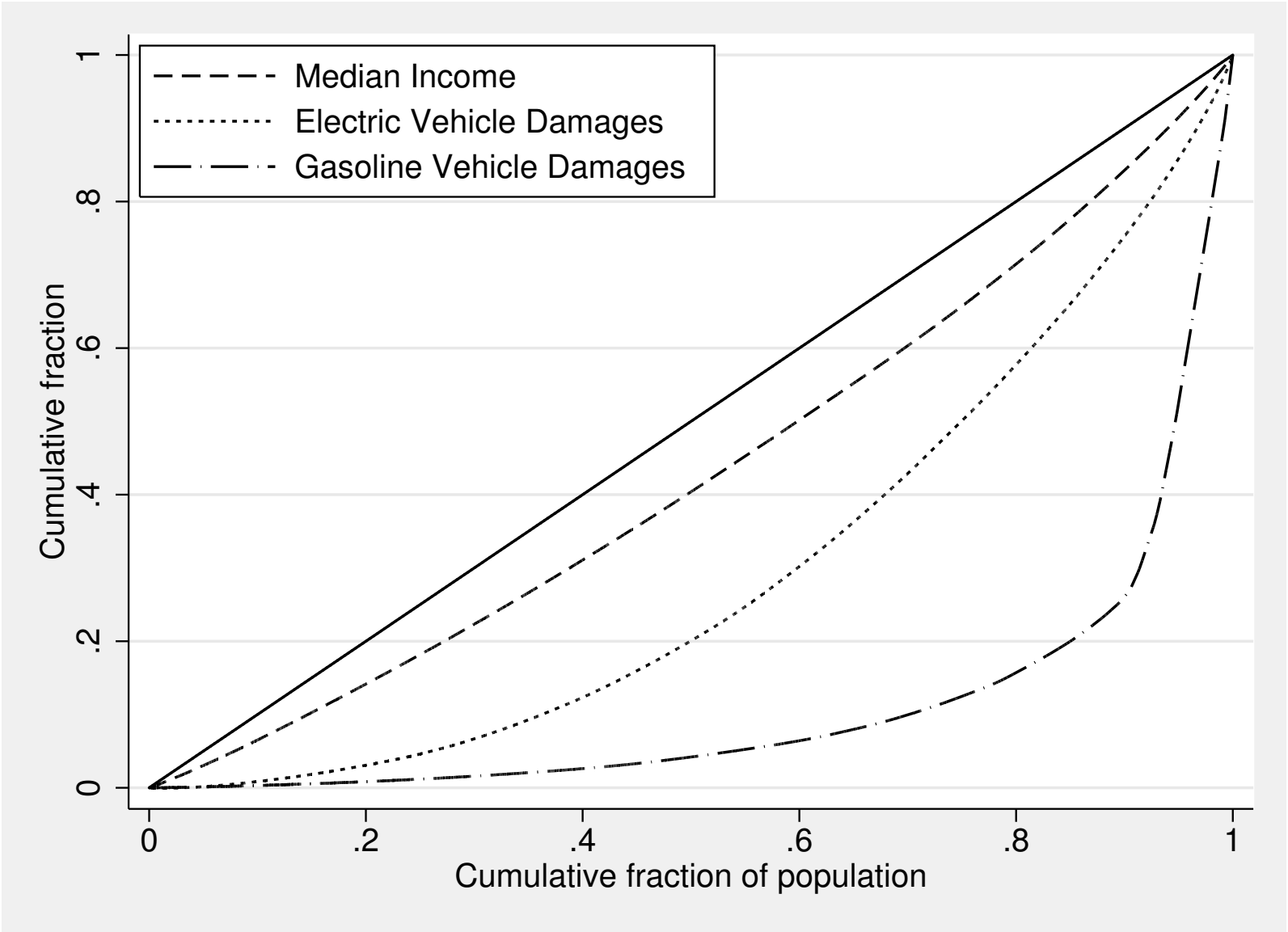
Environmental Benefits Received by County ($1,000)



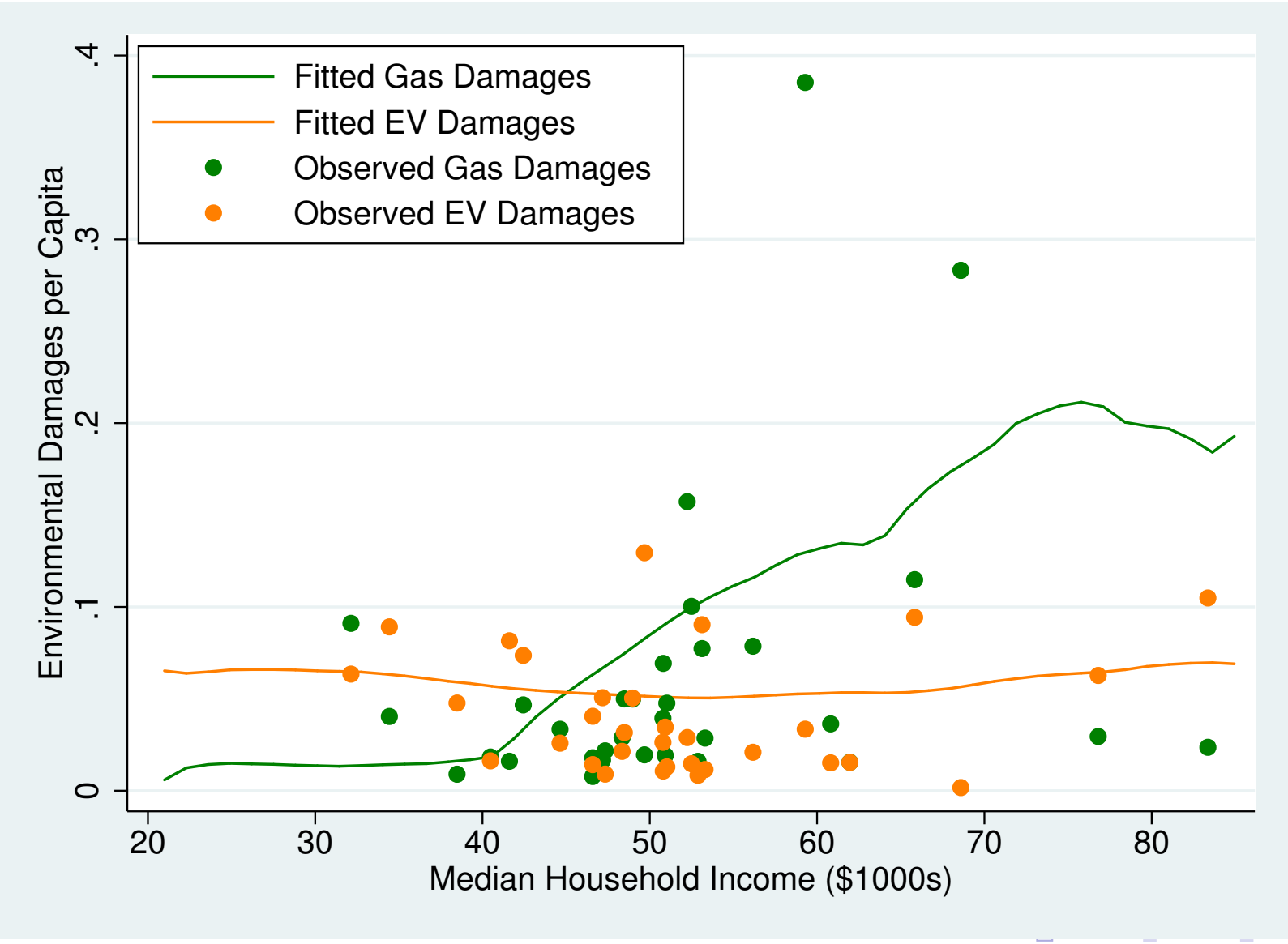
Damages and Environmental Benefits Recieved

Variable	Mean	Std. Dev.	Min	Max
Gas vehicle damages p.c.	0.086	0.2	0.001	1.047
Elec vehicle damages p.c.	0.056	0.041	-0.013	0.309
EV net benefits p.c.	0.03	0.203	-0.301	1.014

Lorenz curves for damages received



Environmental Damages Received And Income



Environmental Benefits Received per Capita, Income, and Race

	Demographic Group				
Income Decile	Black	Hispanic	Asian	White	All
1	-0.050	-0.010	-0.030	-0.063	-0.052
2	-0.050	-0.011	-0.034	-0.061	-0.051
3	-0.044	-0.013	-0.023	-0.048	-0.043
4	-0.037	-0.003	-0.015	-0.036	-0.030
5	0.032	0.012	0.021	-0.030	-0.013
6	0.016	0.014	0.029	-0.010	0.001
7	0.289	0.393	0.393	0.111	0.232
8	0.057	0.129	0.128	0.022	0.045
9	0.076	0.278	0.419	0.088	0.145
10	0.019	0.165	0.214	0.033	0.071
Total	0.016	0.116	0.202	-0.002	0.030

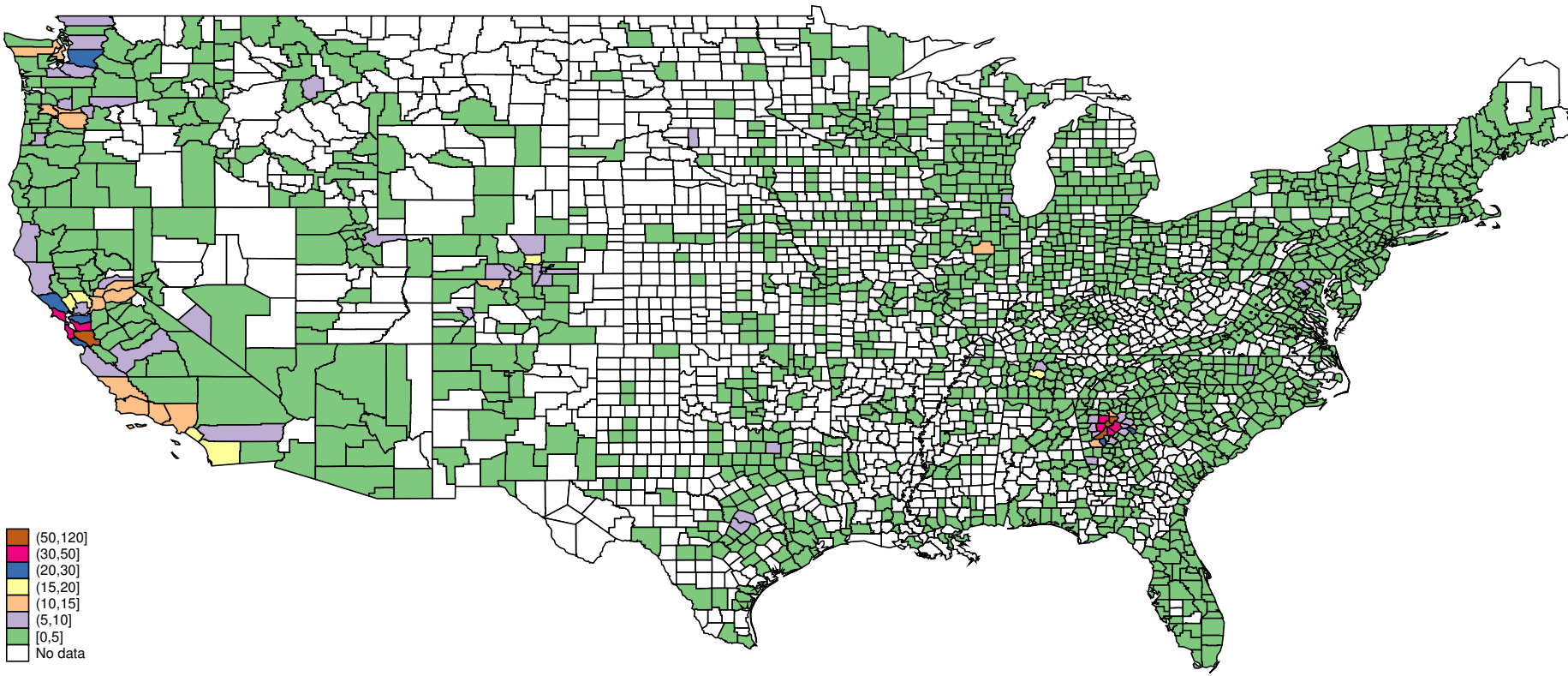
Descriptive Regressions of Environmental Benefits Received per Capita

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HH Income (10k)	0.037***		0.039***	0.037***	0.039***			
	(0.011)		(0.010)	(0.011)	(0.010)			
Share White		-0.426***	-0.431***				-0.533***	-0.412***
		(0.136)	(0.134)				(0.149)	(0.139)
Share Black				-0.025	0.028			
				(0.078)	(0.065)			
Share Hispanic					0.509***			
					(0.195)			
Share Poverty						-0.084	-0.980***	
						(0.214)	(0.242)	
Urban Indicator								0.026***
								(0.008)

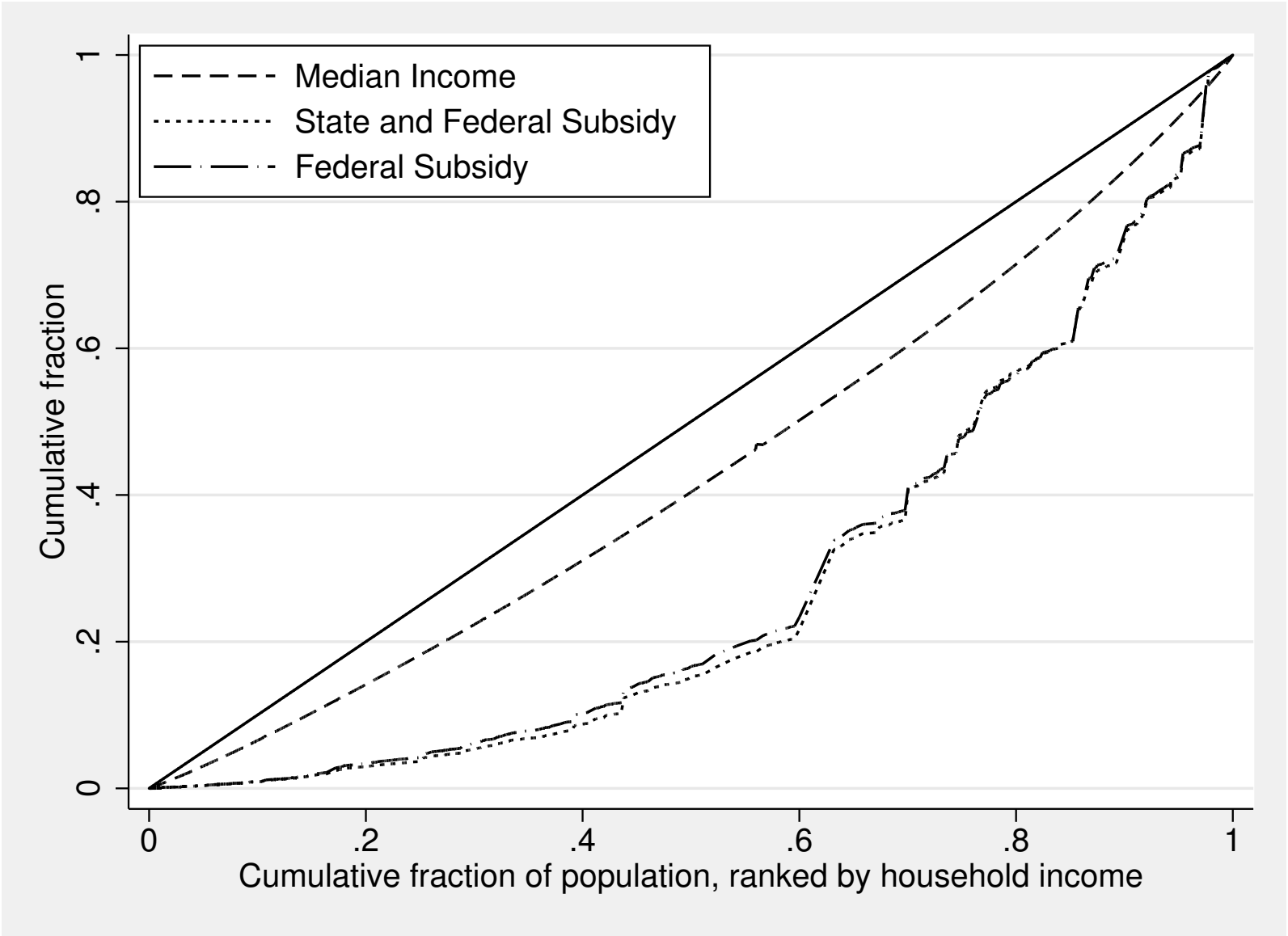
*** p<0.01, ** p<0.05, * p<0.10 *Notes:* These WLS regressions weight by total population and cluster standard errors by county.

Pecuniary Benefits from Subsidies

Subsidy (State and Federal) per capita by county



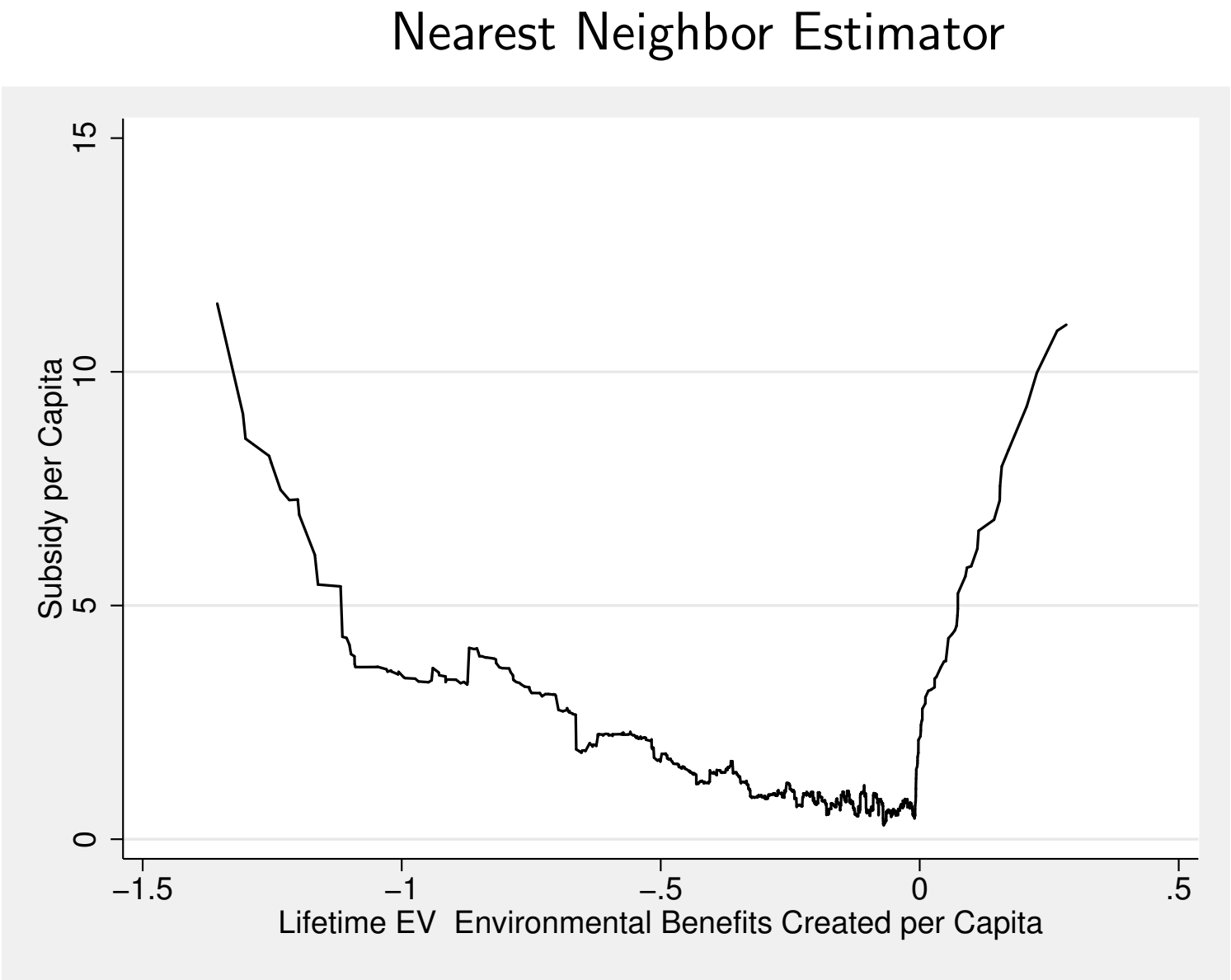
Subsidy Concentration Curves



Two Views of Subsidies

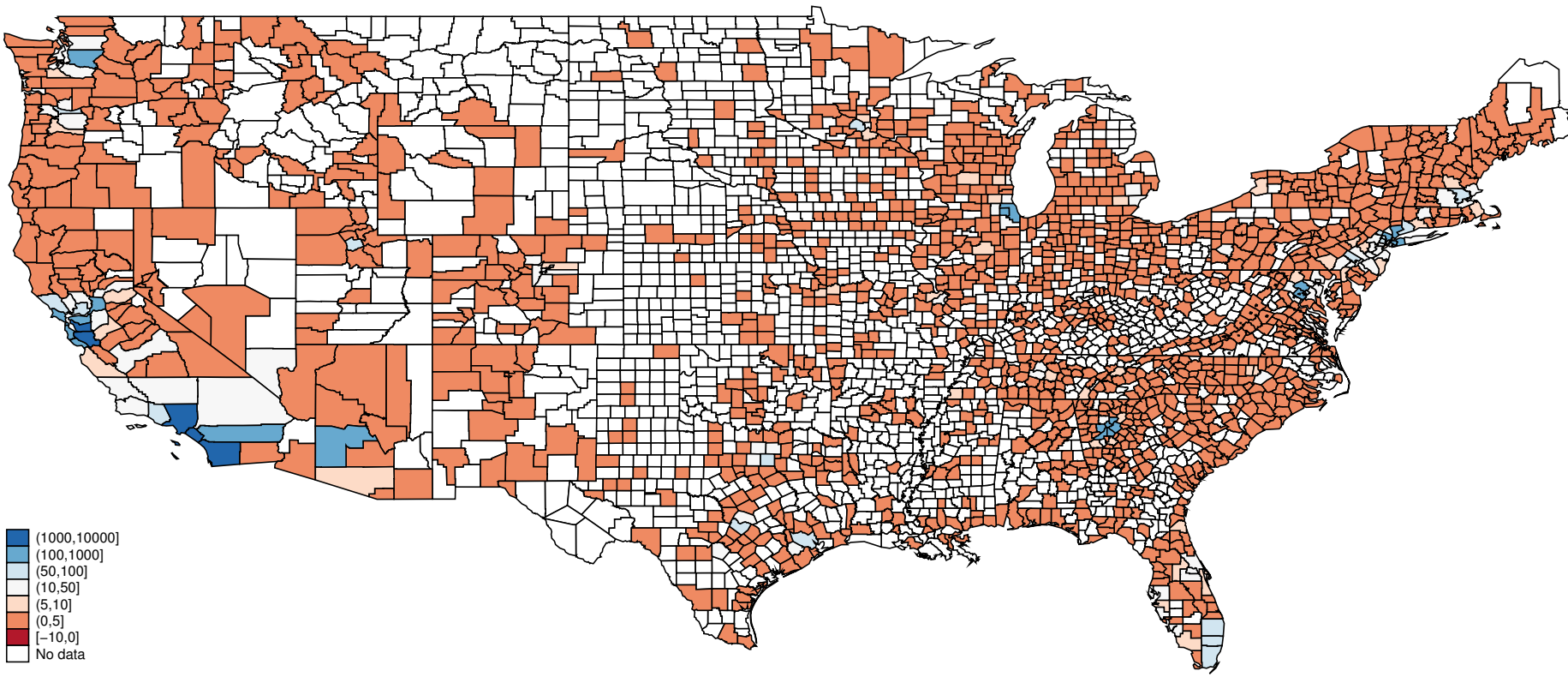
- Borenstein and Davis (2015)
  - Use individual tax return data
  - Bottom 80% of taxpayers by income receive 10% of federal subsidies
- Our findings
  - Use county data
  - We find bottom 80% of population by income live in counties that recieve 55% of federal subsidies

Subsidies Received and Environmental Benefits Created

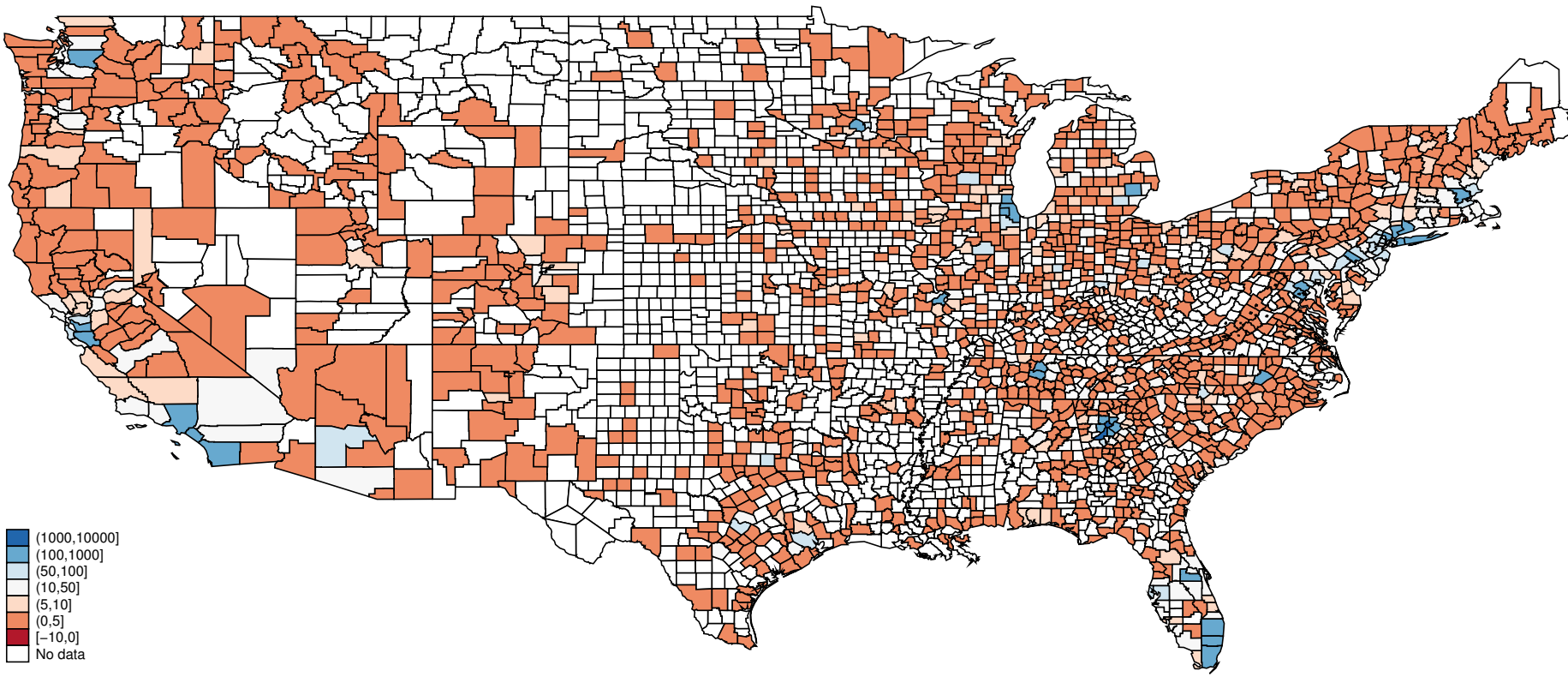


Comments?

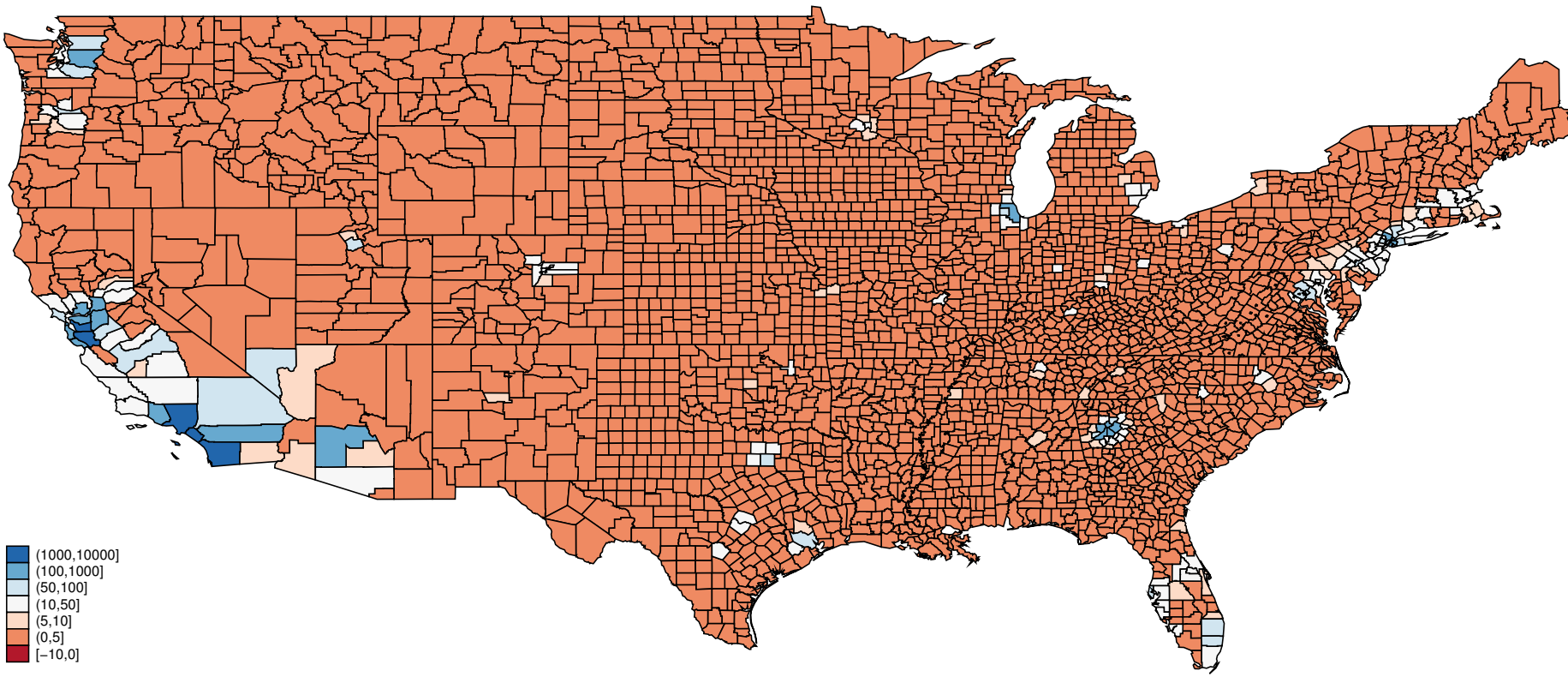
Gasoline Damages Created by County ($1,000)



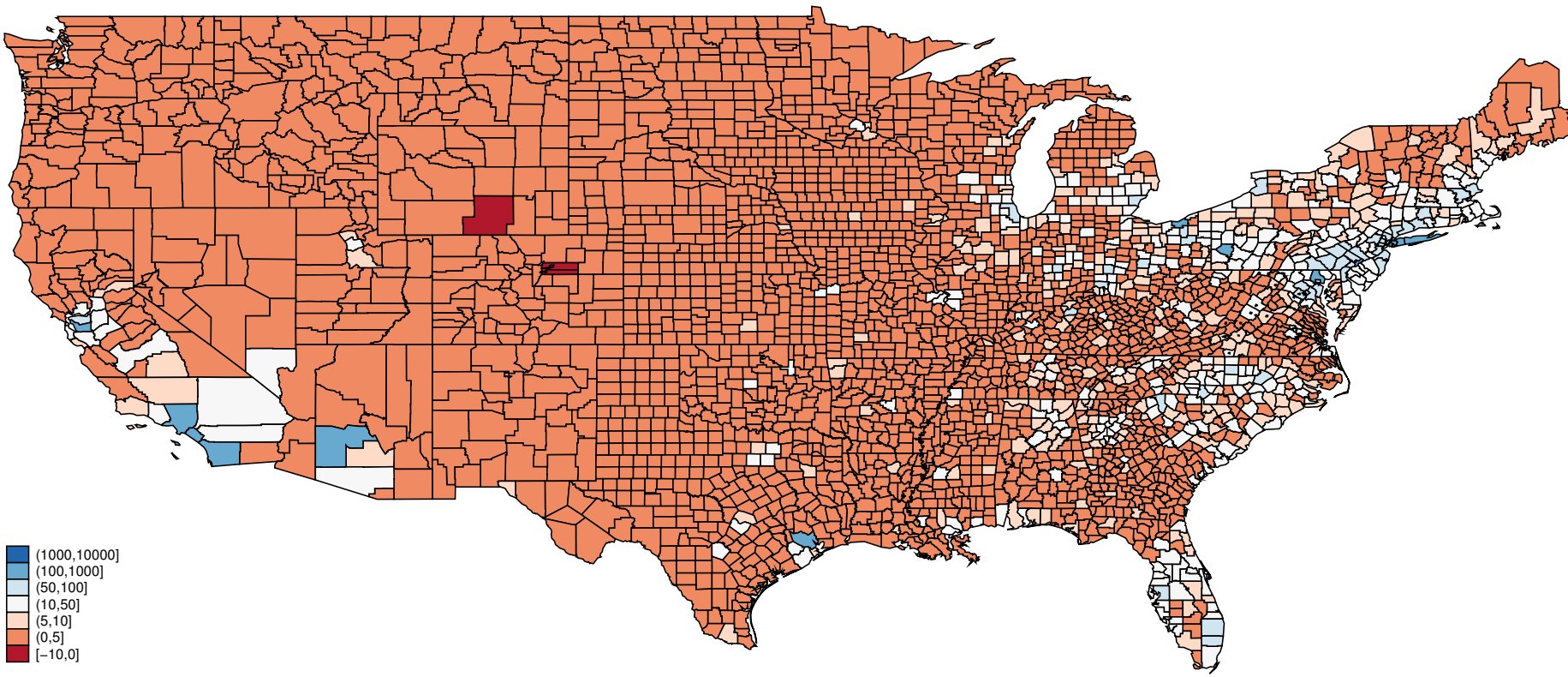
Electric Damages Created by County ($1,000)



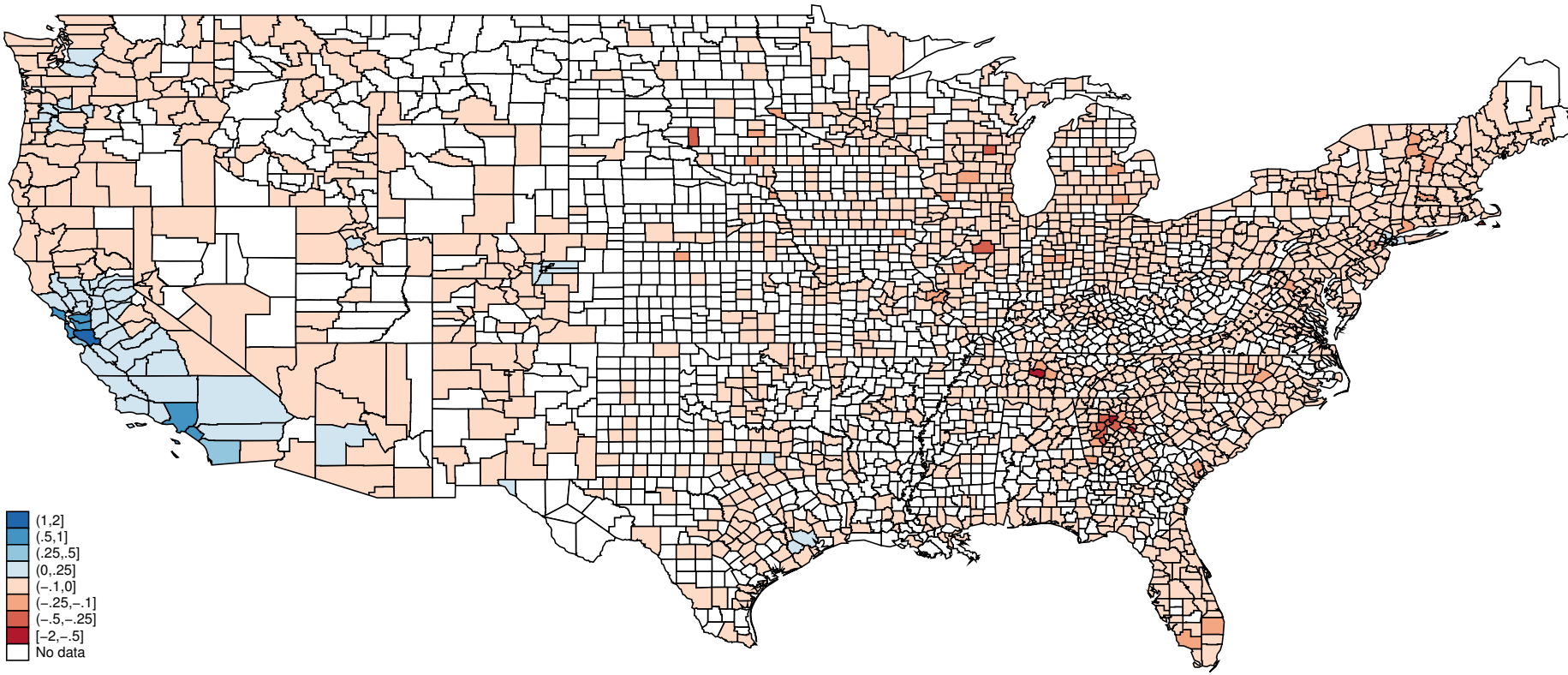
Gasoline Damages Received by County ($1,000)



Electric Damages Received by County($1,000)



Environmental Benefits Per Captia Created by County



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US Census Data

Variable	Mean	Std. Dev.	Min	Max
Population (millions)	0.1	0.318	0	9.888
Median HH Income (10k)	5.222	1.373	2.099	11.953
Share Black	0.131	0.131	0	0.857
Share Hispanic	0.165	0.166	0	0.957
Share Asian	0.048	0.056	0	0.338
Share White	0.64	0.218	0.028	0.992
Urban Indicator	0.838	0.368	0	1
Share Poverty	0.16	0.056	0.029	0.499

Back

Subsidies Received and Environmental Benefits Received

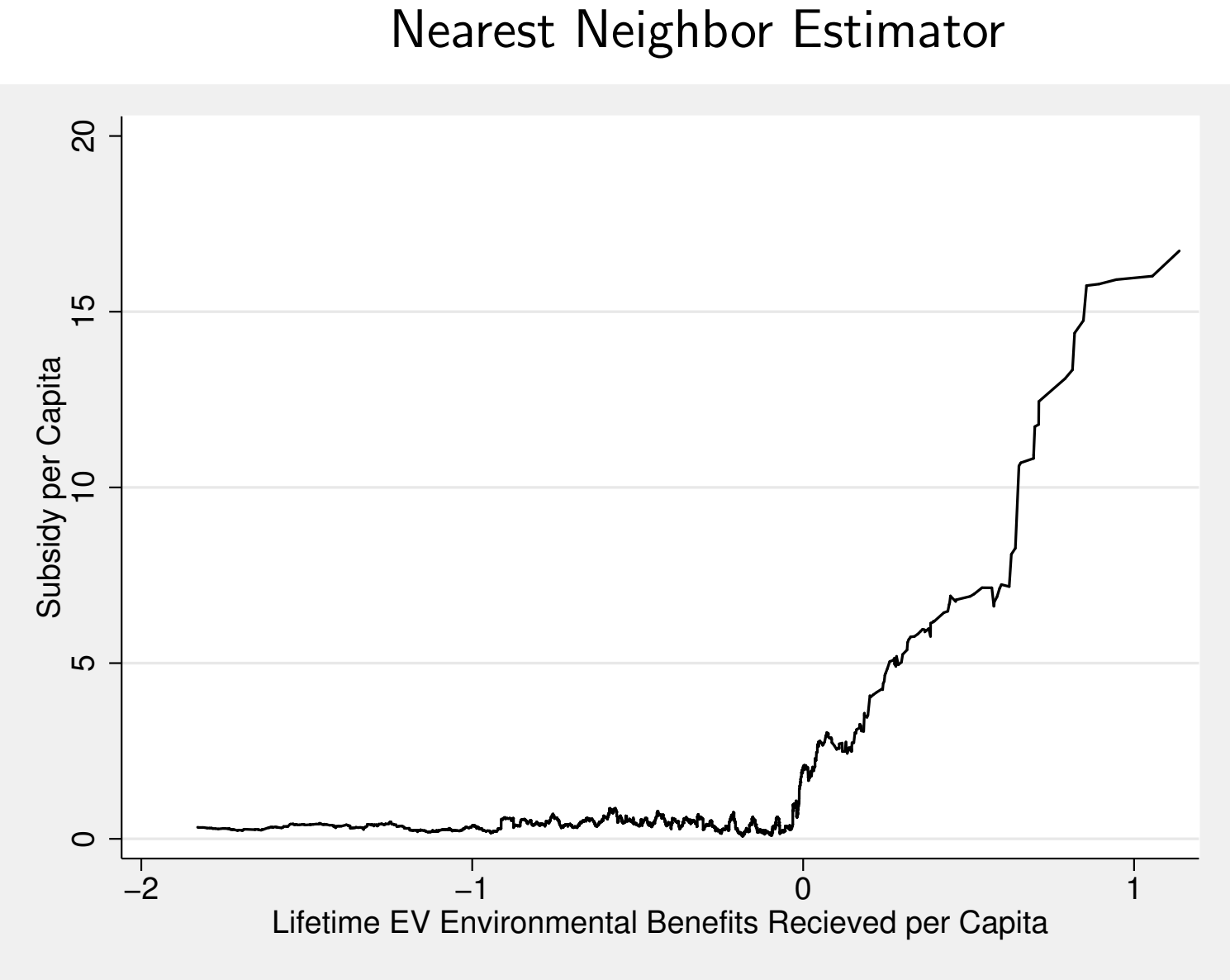

Table: IPUMS vs Non IPUMS

	In IPUMS Sample?		
Variable	No	Yes	
Median HH Income	4.888	5.451	0.562***
	(1.417)	(1.293)	
Share Black	0.108	0.147	0.039***
	(0.136)	(0.126)	
Share Hispanic	0.102	0.208	0.106***
	(0.138)	(0.171)	
Share Asian	0.0207	0.0662	0.046***
	(0.0263)	(0.0626)	
Share White	0.747	0.567	-0.181***
	(0.197)	(0.201)	
Share Urban	0.624	0.985	0.362***
	(0.485)	(0.121)	
Share Poverty	0.161	0.159	-0.001
	(0.0585)	(0.0534)	

*** p<0.01, ** p<0.05, * p<0.10

Notes: The IPUMS sample has 1,630,867 observations from 373 counties. All standard errors are clustered by county.

Table: IPUMS Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: OLS							
HH Income (10k)	0.017**		0.015**	0.023***	0.022***	0.022***	0.013***
	(0.007)		(0.007)	(0.007)	(0.006)	(0.006)	(0.003)
Black		-0.048**	-0.043*	-0.019	0.002	-0.001	0.023***
		(0.024)	(0.024)	(0.017)	(0.015)	(0.015)	(0.007)
Hispanic				0.118**	0.138**	0.133**	0.014
				(0.056)	(0.062)	(0.061)	(0.015)
Asian					0.226***	0.222***	0.078***
					(0.054)	(0.053)	(0.014)
Share Urban						0.190***	0.071***
						(0.040)	(0.021)
State FE	No	No	No	No	No	No	Yes
Panel B: WLS							
HH Income (10k)	0.017***		0.015**	0.023***	0.022***	0.022***	0.013***
	(0.007)		(0.006)	(0.007)	(0.006)	(0.006)	(0.003)
Black		-0.041*	-0.037*	-0.014	0.005	0.002	0.021***
		(0.022)	(0.022)	(0.015)	(0.014)	(0.014)	(0.006)
Hispanic				0.099**	0.117**	0.113**	0.011
				(0.046)	(0.051)	(0.050)	(0.012)
Asian					0.196***	0.193***	0.070***
					(0.048)	(0.048)	(0.013)
Share Urban						0.187***	0.066***
						(0.037)	(0.018)
State FE	No	No	No	No	No	No	Yes

*** p<0.01, ** p<0.05, * p<0.10

Notes: In the WLS regressions, we weight by IPUMS weights. All standard errors are clustered by county. There are 1,630,867 observations.

Descriptive Regressions of Environmental Benefits Received per Capita

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
HH Income (10k)	0.037***							-0.025	-0.010
	(0.011)							(0.026)	(0.015)
Share Black		-0.108						-0.070	-0.052
		(0.087)						(0.093)	(0.073)
Share Hispanic			0.504**					0.230**	0.019
			(0.200)					(0.104)	(0.078)
Share Asian				2.593***				2.665***	1.236***
				(0.540)				(0.591)	(0.402)
Share Poverty					-0.084			-0.272	-0.482*
					(0.214)			(0.433)	(0.280)
Pop Density						0.075**		-0.001	0.054***
						(0.029)		(0.016)	(0.018)
Urban Indicator							0.105***	-0.017	-0.034***
							(0.028)	(0.012)	(0.009)
State FE	No	No	No	No	No	No	No	No	Yes

*** p<0.01, ** p<0.05, * p<0.10 *Notes:* These WLS regressions weight by total population and cluster standard errors by county. There are 3107 observations.

Environmental Benefits Received and Race