The Causal Effect of Medicaid on Mortality: New Evidence from the Universe of Low-Income Adults

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Evolution of the literature on health insurance and mortality

- Given Medicaid's central and growing importance in the U.S. health care system, understanding its effect on mortality, an unambiguous indicator of health and wellbeing, is crucial
- Until recently, a large body of experimental and quasi-experimental literature offered "limited reliable evidence on how health insurance affects health" beyond certain vulnerable sub-populations (Levy and Meltzer 2008, Black et al. 2019)
- Miller, Johnson, and Wherry (2021) and Goldin, Lurie, and McCubbin (2021) challenged the prevailing view using large-scale individual data and compelling research designs, finding that insurance substantially reduces mortality for older adults
  - In both studies, however, confidence intervals for treatment-on-the-treated include both very small and very large effects, making it difficult to assess the magnitude of this relationship
- An important remaining question is whether, and by how much, insurance reduces mortality in the general adult population

New evidence from the universe of low-income adults

- In this paper, we examine the causal effect of Medicaid on mortality in the general adult population
  - Analyses adhere to a pre-registered analysis plan (link)
- We identify the U.S. population of low-income, non-disabled adults likely to have gained eligibility under the ACA expansions and earlier waivers by linking the 2010 Census to administrative tax and disability program data
  - 37 million linked individuals in 2010
- We then link these individuals to administrative data on Medicaid enrollment and all-cause mortality and use the adoption and timing of expansions across states to identify effects on mortality
- We also examine heterogeneity by age, gender, race, Hispanic ethnicity, employment, income, and family status and estimate our model on samples designed to align with those used in prior studies

Preview of key findings

- We estimate that expansions led to a 12 ppt increase in the enrollment of low-income, non-disabled adults and reduced the annual mortality hazard by about 2.5% in expansion states compared to non-expansion states (95% CI: 0.4-4.4%)
- Assuming no spillovers, this suggests a 21% reduction in the mortality hazard of people who enrolled in Medicaid as a result of the expansions
  - 95% CI for treatment on the treated (3.4-39%) falls within the intervals produced by key prior studies but excludes their large mortality reduction point estimates
- Proportional treatment-on-the-treated estimates are not significantly different across subsets of the population by age, race, ethnicity, gender, family status, income, and employment
- Our estimates suggest Medicaid expansions cost $5.5 million per life saved or about $168,000 per life-year saved
  - Cost per life is well below the $10-11 million valuation of a statistical life used in federal government cost-benefit analyses
  - Cost per life-year is lower than Braithwaite et al. (2008)'s estimate that the societal willingness-to-pay for each additional life-year is $217,000-314,000
  - Nearly half of life-years saved accrue to younger cohorts (ages 19-39 in 2010) because of their longer life expectancies and greater representation in the low-income adult population

Contributions

- We add to a growing body of evidence that insurance, and Medicaid in particular, improves health, while also suggesting that mortality reductions are not limited to older adults and improving the precision of estimates
  - Pre-registration of analysis plan bolsters findings' credibility
- Mortality reductions do not appear to be limited to the near elderly, as found in prior work – our estimates are general to the entire population of potential beneficiaries under recent expansions
- Estimates suggest that expansions of Medicaid to low-income adults under the ACA and earlier expansions may be cost-effective based on mortality reductions alone

Data and Methods

Identifying the population targeted by Medicaid expansions

- We link anonymized individual data from the 2010 Census to administrative tax data to identify adults (19-59) in families with income below 138% of the poverty line
  - About 90% of people in the Census are assigned a linkage key; we adjust for non-linkage using inverse probability weights
  - We identify families in the Census using the household relationship variables reported there; this allows us to group about 98% of people into families with a high degree of certainty
- To estimate income, we link these individuals to the universe of 1040 records, relying on W-2s and 1099-Rs for non-filers
  - Consistent with Medicaid eligibility guidelines, we define income to be a slightly modified version of Adjusted Gross Income (AGI)
  - We address various methodological issues in calculating family income using an approach adapted from Meyer et al. (2020)
- We also link our sample to 2009 Medicaid and Medicare records to identify disability program participants; we exclude these individuals from our main analyses because they were eligible for Medicaid or Medicare prior to expansions

Data on Medicaid enrollment and mortality

- We observe Medicaid enrollment by linking our sample to administrative datasets from the Centers for Medicare and Medicaid Services (2005-2019)
- We obtain death dates by linking our sample to the Census Bureau's Numerical Identification File, or "Numident" (2010-2022)
  - The Numident, which is derived from Social Security Administration (SSA) records, has been shown to be a "high-quality and timely source of data to study all-cause mortality" (Finlay and Genadek 2021)
  - Does not indicate cause of death

Identifying expansion dates

- While most states expanded Medicaid on or after Jan. 1, 2014, several offered broad Medicaid eligibility in earlier years (Burns et al. 2016)
- For states with early expansions, we identify the date when most childless, low-income, non-disabled adults became eligible for Medicaid
  - We do not classify states as early expanders if eligibility was tied to employment, required premium contributions, if limited spots were available, or if enrollment was frozen prior to the ACA expansions
  - We do classify states as early expanders even if coverage was not comprehensive
- This approach leads us to classify six states as having expanded before 2010 (DE, HI, NY, VT in 1996; MA in 1997; MD in 2006) and six states as having expanded between 2010 and 2014 through the ACA's "early expansion" option (CT, CA, DC, MN in 2010 and NJ, WA in 2011)

Estimating the effect of expansions on Medicaid enrollment

- To estimate the effect of the expansion on enrollment, we consider the following model, where Y_{ist} is a measure of Medicaid enrollment for person *i* in state *s* and year *t* (ever enrolled in year or days of enrollment in year):

$$Y_{ist} = \tau * 1\{t \geq t_s^*\} + \delta_s + \delta_t + \gamma' X_{ist} + \epsilon_{ist}$$

- τ is the average effect of expansion on enrollment; δ_s and δ_t are state and year fixed effects; X_{ist} is a vector of covariates
  - X_{ist} includes age group dummies, race, Hispanic ethnicity, gender
- t_s^* is the year state *s* expanded Medicaid to low-income adults
  - $1\{t \geq t_s^*\}$ is zero in all periods for non-expansion states
- To assess parallel trends, we also estimate an event study specification where the post-period indicator is replaced with a sum of event time dummies
  - Equal to zero in all periods for non-expansion states

Estimating the effect of expansions on mortality hazard

- We specify the mortality hazard $\lambda_i(t)$ using a discrete time model with a non-parametric baseline hazard, which we parameterize using a proportional form:

$$\lambda_i(t) = \lambda_0(t)\exp(z_i(t)'\beta)$$

  - $\lambda_0(t)$ is the unknown annual baseline hazard in year t
  - $z_i(t)$ is a vector of time-dependent explanatory variables (covariates) for individual i
  - β is a vector of parameters to be estimated
- To estimate the expansions' effect on mortality hazard, we let

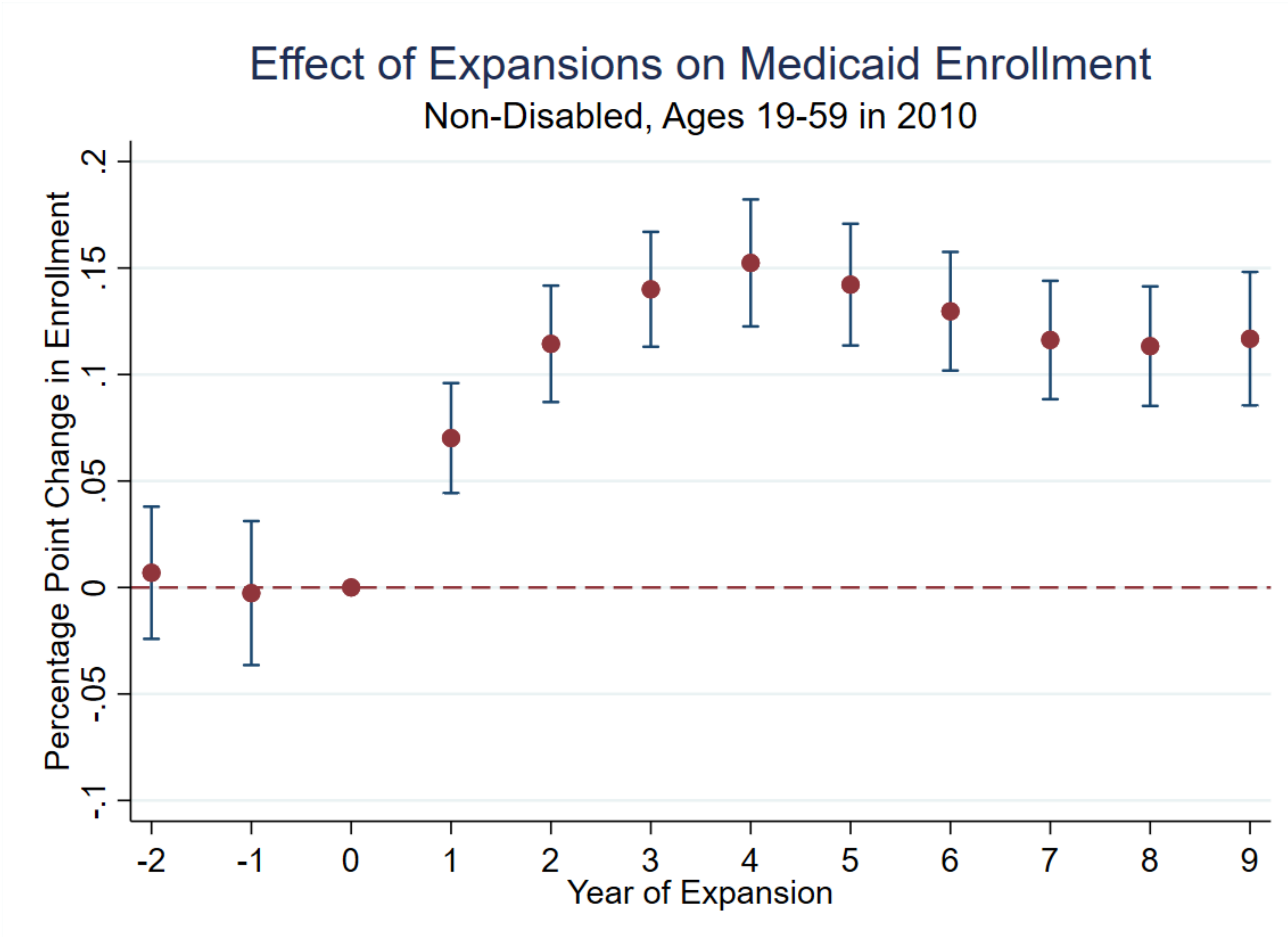
$$z_{ist}(t)'\beta = \tau * 1\{t \geq t_s^*\} + \delta_s + \delta_t + \gamma' X_{ist}$$

- As with enrollment, we assess parallel trends by estimating an event study specification replacing the post-period indicator with a sum of event time dummies

Results

Table 1: Summary Statistics
Non-Disabled Adults with Income <1.38 x Federal Poverty Level (FPL)
Ages 19-59 in 2010

Died During Study Period (2010-2022)	0.0504
Age in 2010	
Mean	34.61
19-24	0.2666
25-29	0.1616
30-34	0.1198
35-39	0.1026
40-44	0.0986
45-49	0.0946
50-54	0.0830
55-59	0.0651
Female	0.5189
Black	0.1766
Other Race	0.1657
Hispanic	0.2082
Married	0.2573
Parent	0.3694
Income in 2009	
None	0.2583
0-0.5 x FPL	0.2304
0.5-1 x FPL	0.2933
1-1.38 x FPL	0.2180
N (Weighted)	42,270,000
N (Unweighted)	37,460,000



Effect of Expansions on Medicaid Enrollment
Non-Disabled, Ages 19-59 in 2010
Percentage Point Change in Enrollment
-.1
-.05
0
.05
.1
.15
.2
-2
-1
0
1
2
3
4
5
6
7
8
9
Year of Expansion

Table 2: Difference-in-Differences Estimates of Effect of Expansions on Medicaid Enrollment

	Non-Disabled		All	
	Ever in Year	Days in Year	Ever in Year	Days in Year
Post x Expansion	0.117***	35.81***	0.106***	32.57***
	(0.017)	(5.992)	(0.016)	(5.808)
N (People x Years)	441,200,000	441,200,000	489,300,000	489,300,000
N (People)	37,460,000	37,460,000	41,930,000	41,930,000
Mean Medicaid Enrollment				
Expansion States (Pre-Period)	0.24	67.97	0.30	89.82
Non-Expansion States	0.20	51.56	0.25	68.65
Demographic controls	Yes	Yes	Yes	Yes
Fixed effects	State, Year	State, Year	State, Year	State, Year
SE Clustering	State	State	State	State

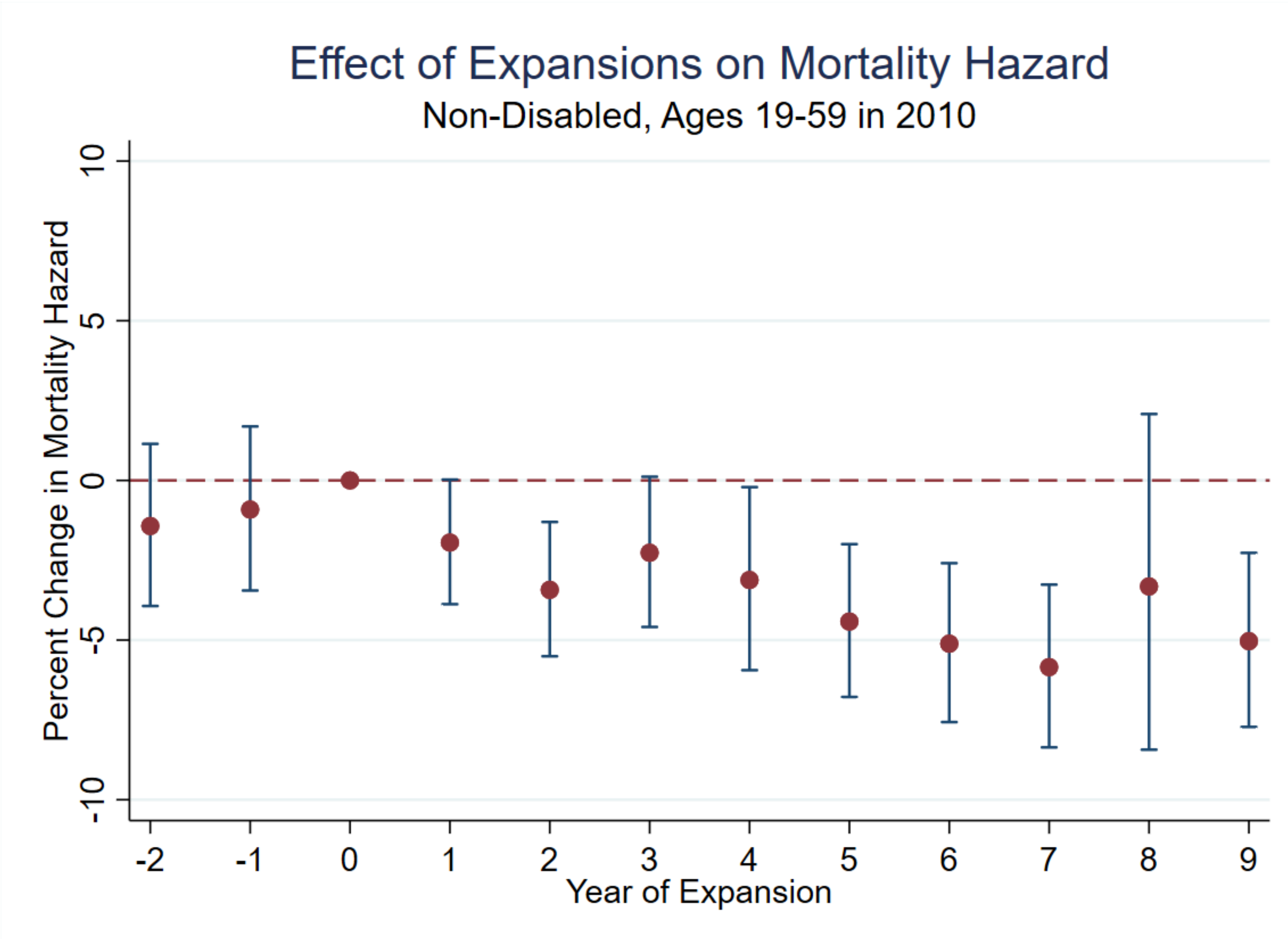

Effect of Expansions on Mortality Hazard
Non-Disabled, Ages 19-59 in 2010
Percent Change in Mortality Hazard
10
5
0
-5
-10
-2
-1
0
1
2
3
4
5
6
7
8
9
Year of Expansion

Table 3: Effect of Expansions on Mortality Hazard (Reduced Form Estimates)

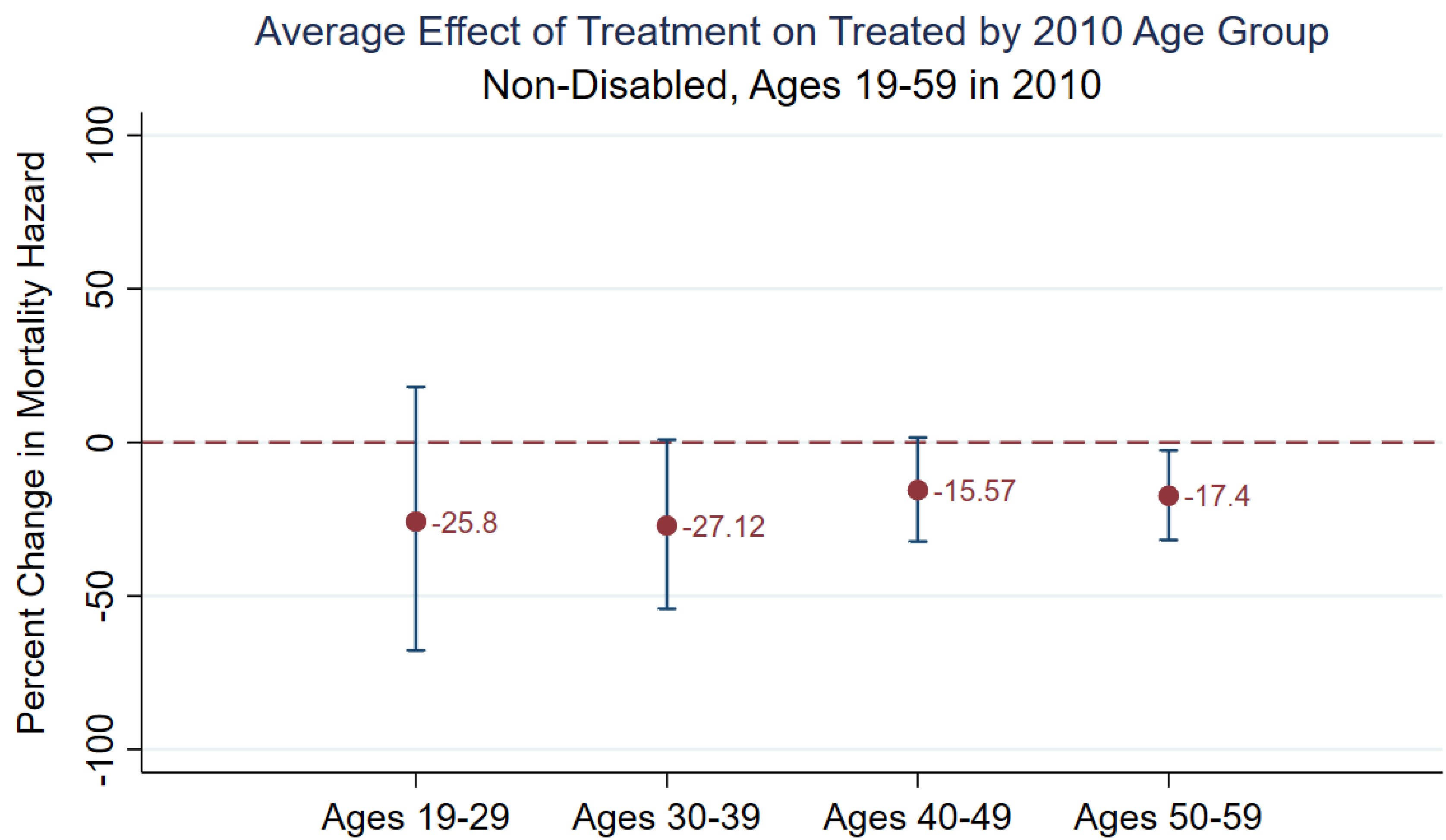
	Non-Disabled		All	
	Died in Year	Pct Change in Mortality Hazard	Died in Year	Pct Change in Mortality Hazard
Post x Expansion	-0.0249**	-2.46%**	-0.0128*	-1.27%*
SE or 95% CI	(0.011)	(-4.52%, -0.40%)	(0.008)	(-25.96%, 2.15%)
N (People x Years)	441,200,000	441,200,000	489,300,000	489,300,000
N (People)	37,460,000	37,460,000	41,930,000	41,930,000
Demographic controls	Yes	Yes	Yes	Yes
Fixed effects	State, Year	State, Year	State, Year	State, Year
SE Clustering	State	State	State	State

Table 4: Estimates of Average Effect of Treatment on the Treated

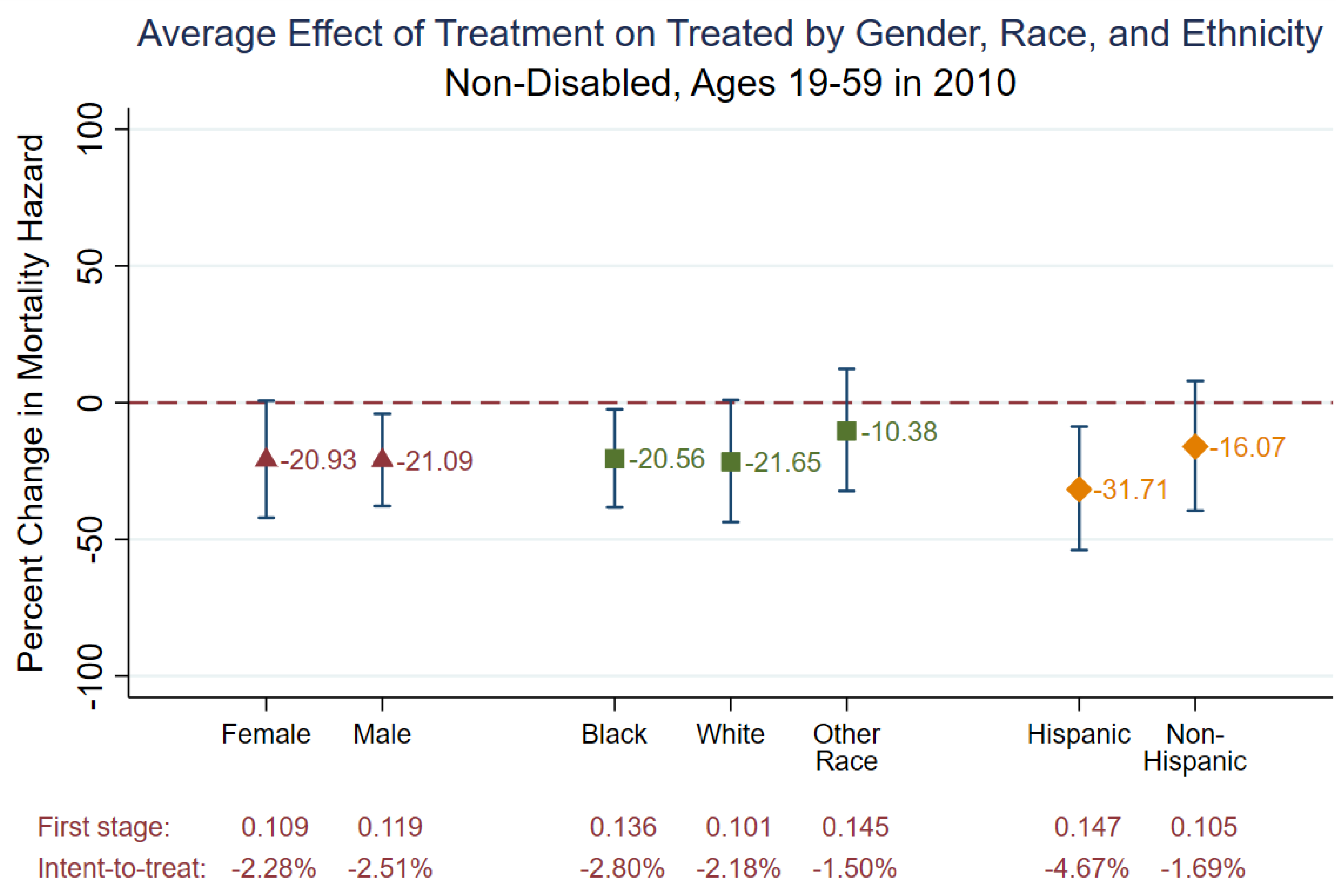
	Non-Disabled		All	
	Ever Enrolled in Year	Full Year of Enrollment	Ever Enrolled in Year	Full Year of Enrollment
ToT Estimate	-21.02%	-25.07%	-12.00%	-14.25%
95% CI - Upper Bound	-3.68%	-4.39%	2.72%	2.35%
95% CI - Lower Bound	-38.00%	-45.32%	-25.77%	-30.61%

Note: Treatment on treated estimate assumes no spillovers, i.e. no effect of Medicaid expansion on people not induced to enroll. Full year of enrollment assumes linear relationship between days of enrollment and mortality hazard reduction. Confidence interval takes first-stage estimate to be fixed (non-stochastic).

Sub-Group Analysis

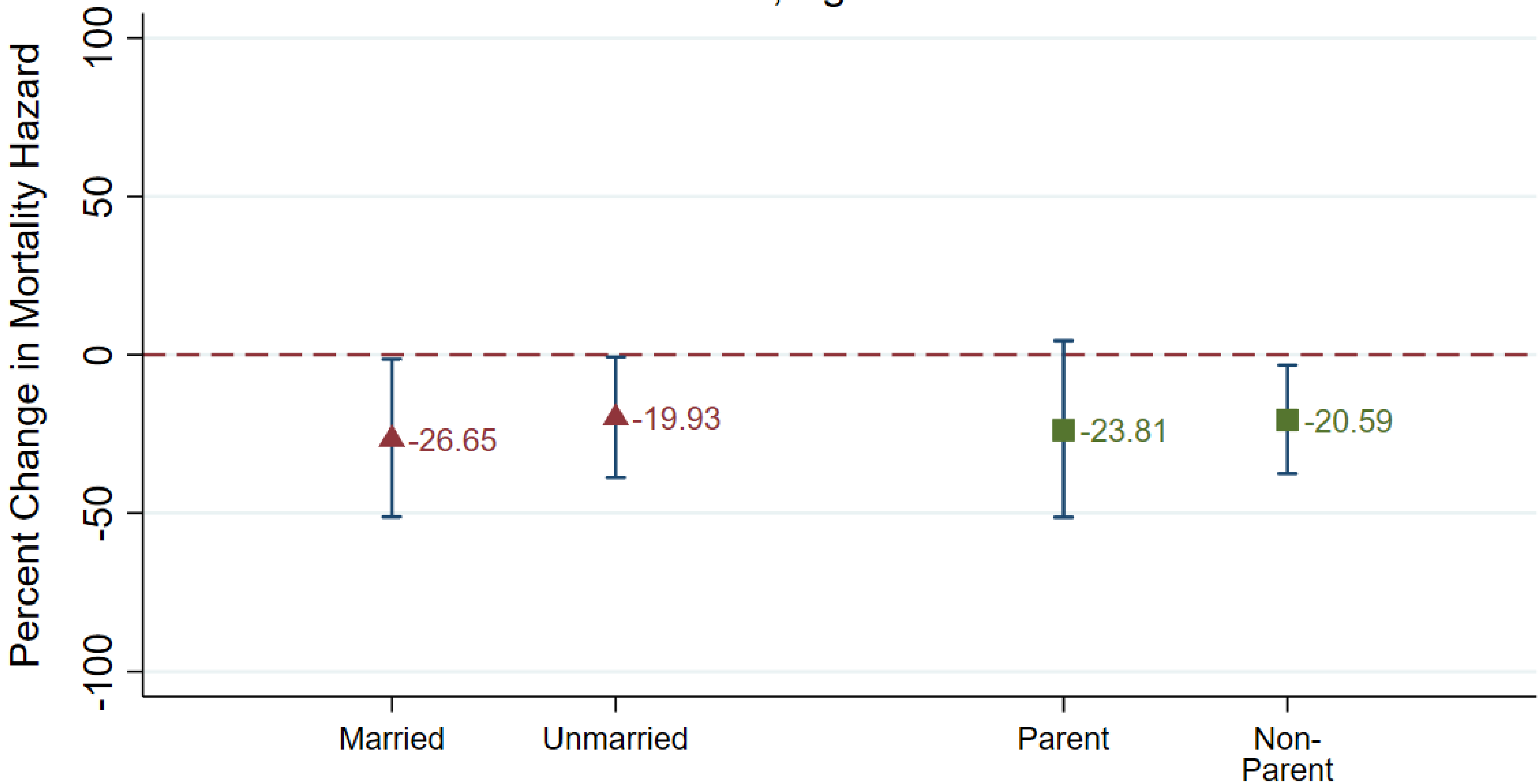


First stage:	0.099	0.113	0.148	0.145
Intent-to-treat:	-2.56%	-3.07%	-2.30%	-2.53%

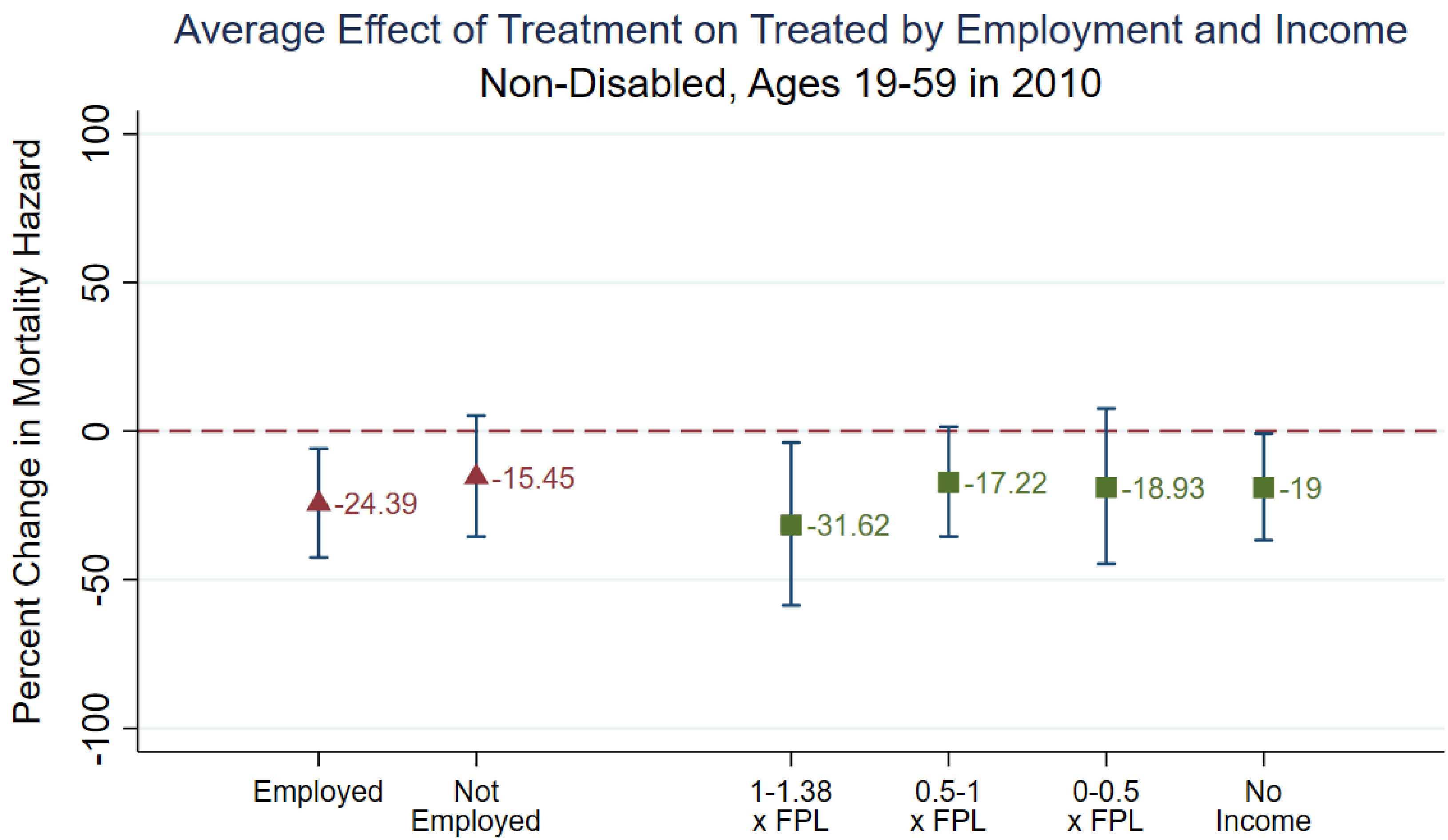

Average Effect of Treatment on Treated by Gender, Race, and Ethnicity
Non-Disabled, Ages 19-59 in 2010
Percent Change in Mortality Hazard
100
50
0
-50
-100
-20.93
-21.09
-20.56
-21.65
-10.38
-31.71
-16.07
Female
Male
Black
White
Other Race
Hispanic
Non-Hispanic
First stage: 0.109 0.119 0.136 0.101 0.145 0.147 0.105
Intent-to-treat: -2.28% -2.51% -2.80% -2.18% -1.50% -4.67% -1.69%

Average Effect of Treatment on Treated by Family Status

Non-Disabled, Ages 19-59 in 2010



	Married	Unmarried	Parent	Non-Parent
First stage:	0.107	0.114	0.094	0.124
Intent-to-treat:	-2.84%	-2.26%	-2.23%	-2.56%

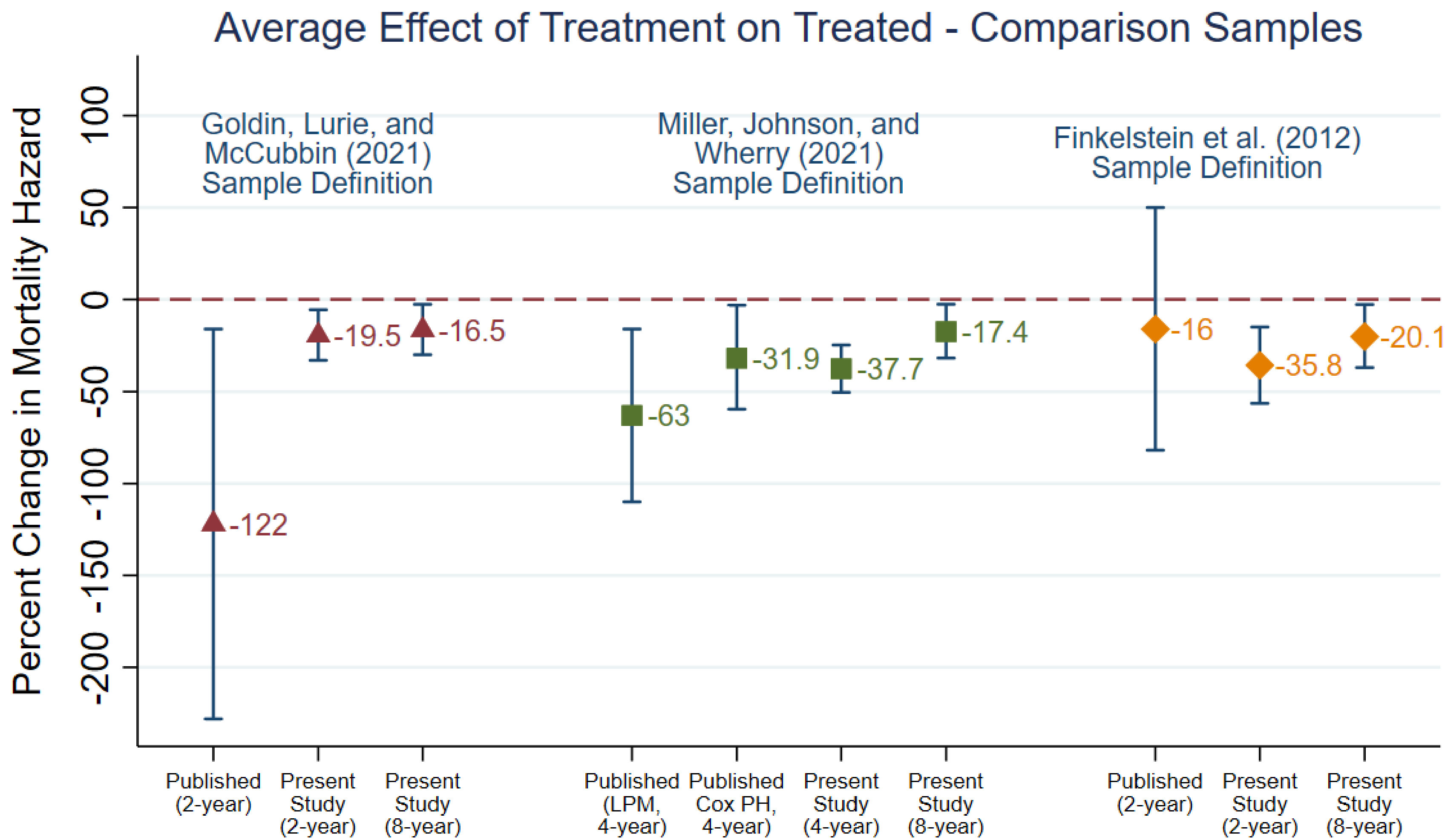


	Employed	Not Employed	1-1.38 x FPL	0.5-1 x FPL	0-0.5 x FPL	No Income
First stage:	0.107	0.132	0.101	0.108	0.110	0.131
Intent-to-treat:	-2.61%	-2.04%	-3.20%	-1.85%	-2.08%	-2.49%

Comparison to Key Prior Studies

Comparison to key prior studies

- We compare our estimates of the average effect of treatment on the treated to three previous studies:
  - Finkelstein et al. (2012) estimate effect of gaining Medicaid through the Oregon Health Insurance Experiment (OHIE)
  - Goldin, Lurie, and McCubbin (2021) use an experiment that randomly assigned uninsured taxpayers to receive a letter informing them of penalties and insurance options
  - Miller, Johnson, and Wherry (2021) link low-income adults from the American Community Survey (ACS) to Medicaid and SSA mortality data and use ACA expansions to estimate effect
- OHIE sample included all poor and includes the disabled; other studies focus on older adults



First stage:		0.100	0.145	0.128	0.128	0.133	0.145		0.064	0.115
Intent-to-treat:		-1.95%	-2.40%	-8.00%	-4.10%	-5.03%	-2.53%		-2.30%	-2.30%

Robustness Checks

Summary of robustness checks

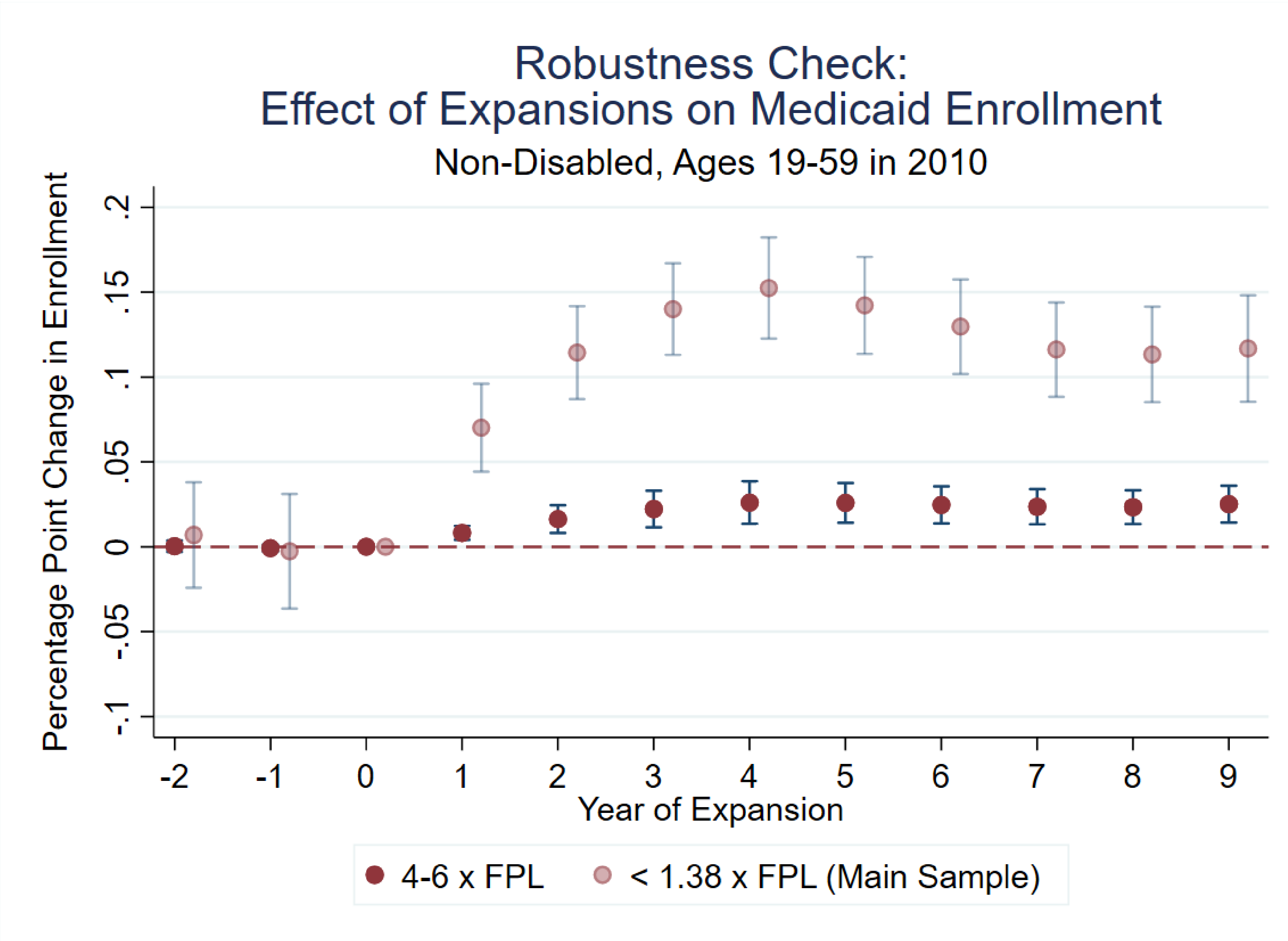
- Our findings change little when we estimate a triple-differences specification using higher income adults
  - Adults with income 4-6 times the poverty line are unlikely to have gained insurance under Medicaid expansions or through ACA marketplace premium subsidies
- We also estimate our model separately for higher income adults and a find small (1.5 ppt) effect on enrollment and statistically insignificant effect on mortality
  - Implied average effect of treatment on treated is similar to the low-income group, but imprecise and not statistically significant
- Finally, we show that parallel trends in Medicaid enrollment persist when we begin our pre-period in 2005 rather than 2010
  - We also show suggestive evidence of parallel mortality pre-trends using aggregate mortality rates in expansion and non-expansion states before 2010

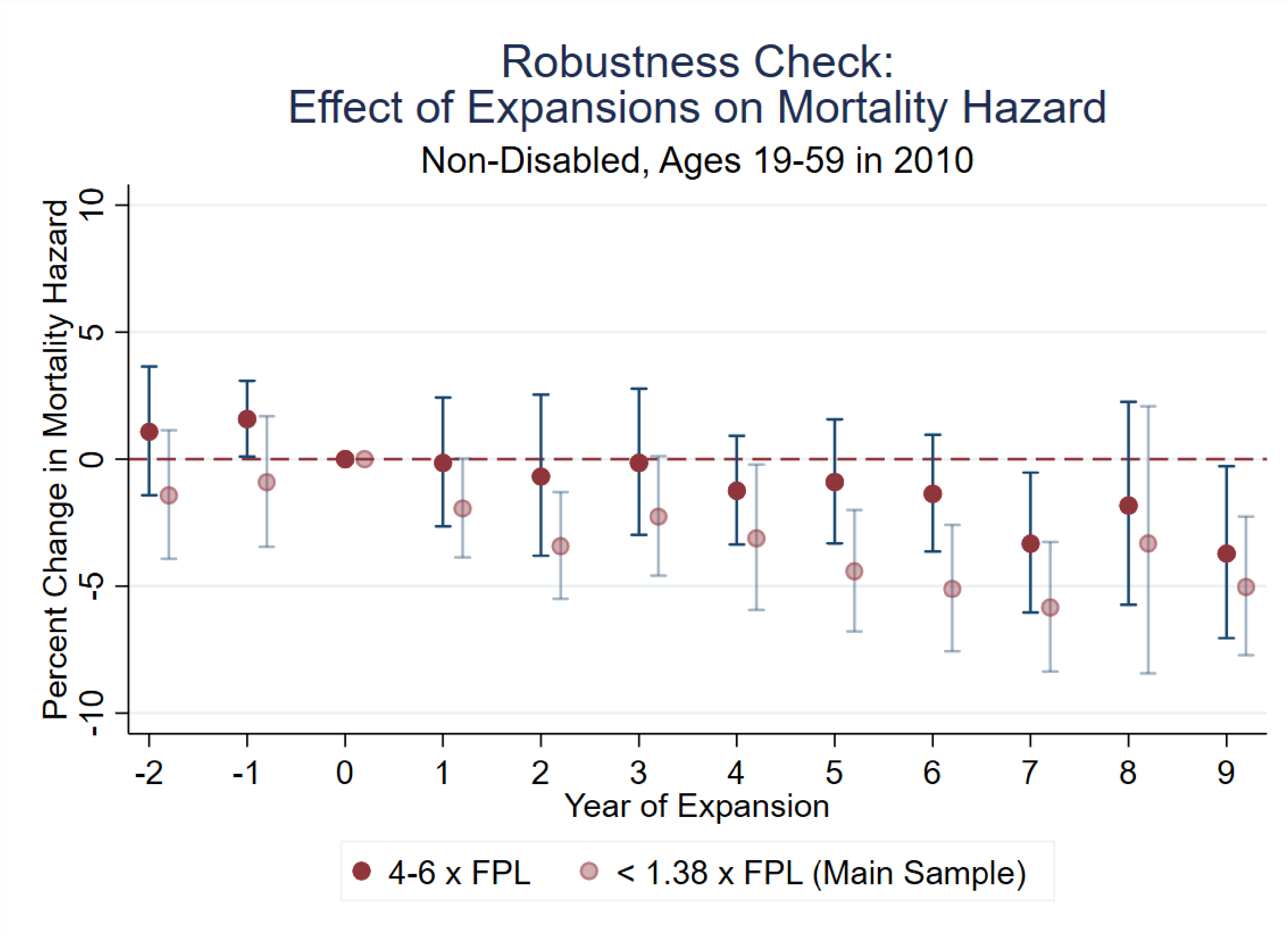
Triple differences estimate of average effect of treatment on the treated

Table 6: Triple Differences Estimates

	Difference in Differences	Triple Differences
ToT Estimate	-21.02%	-17.69%
95% CI - Upper Bound	-3.68%	-3.35%
95% CI - Lower Bound	-38.00%	-31.82%

Note: Both columns report estimates of the average effect of treatment on the treated estimated on the sample of non-disabled adults, where the treatment is being enrolled in Medicaid in a year.

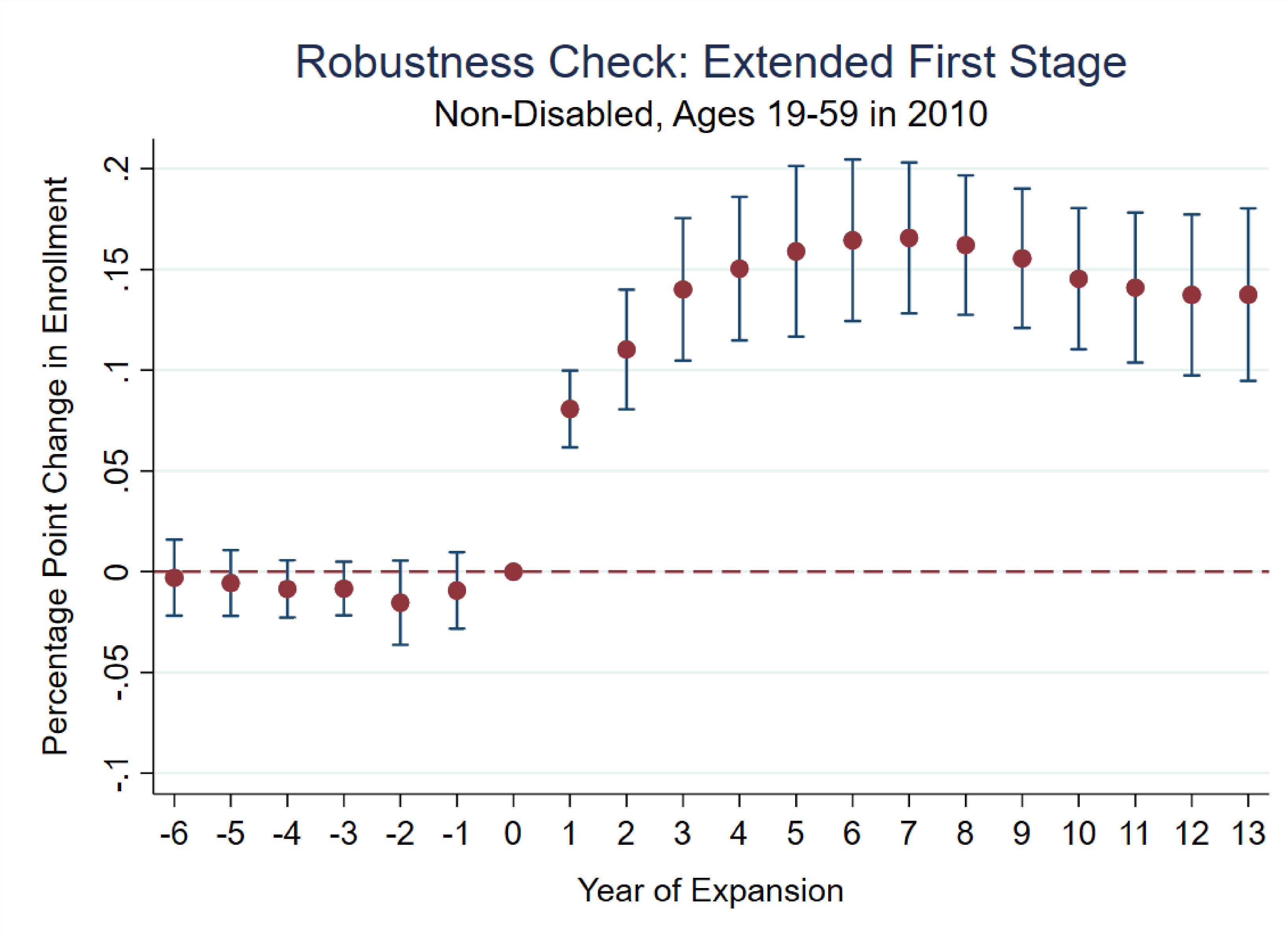

Robustness Check:
Effect of Expansions on Medicaid Enrollment
Non-Disabled, Ages 19-59 in 2010
Percentage Point Change in Enrollment
-.1
-.05
0
.05
.1
.15
.2
-2
-1
0
1
2
3
4
5
6
7
8
9
Year of Expansion
4-6 x FPL
< 1.38 x FPL (Main Sample)


Robustness Check:
Effect of Expansions on Mortality Hazard
Non-Disabled, Ages 19-59 in 2010
Percent Change in Mortality Hazard
10
5
0
-5
-10
-2
-1
0
1
2
3
4
5
6
7
8
9
Year of Expansion
4-6 x FPL
< 1.38 x FPL (Main Sample)

Effect on enrollment and mortality for higher-income population

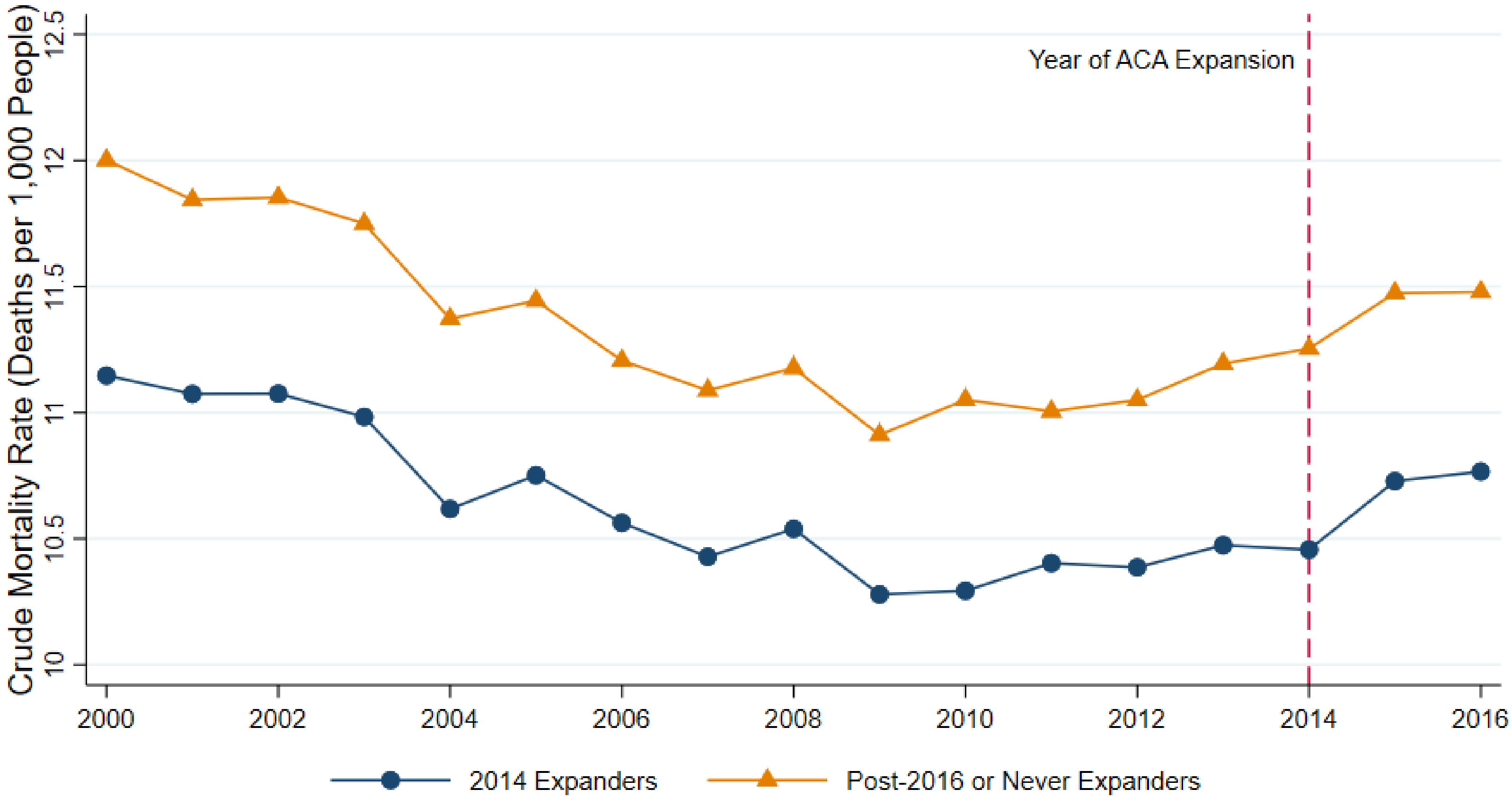
Table 5: High-Income Comparison Group

	First Stage	Reduced Form		Average Effect of Treatment on the Treated	
	Medicaid in Year	Died in Year	% Change in Mortality Hazard	High Income	Main Sample
Post x Expansion	0.0147***	-0.00467	-0.47%	-31.69%	-21.02%
SE or 95% CI	(0.003)	(0.009)	(-2.23%, 1.33%)	(-151.9%, 90.7%)	(-38.00%, -3.68%)
N (People x Years)	274,600,000	274,600,000	274,600,000	274,600,000	441,200,000
N (People)	22,880,000	22,880,000	22,880,000	22,880,000	37,460,000



Robustness Check: Extended First Stage
Non-Disabled, Ages 19-59 in 2010
Percentage Point Change in Enrollment
-.1
-.05
0
.05
.1
.15
.2
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Year of Expansion

Aggregate mortality rates by expansion status in 2000-2016 (Ages 19-59)

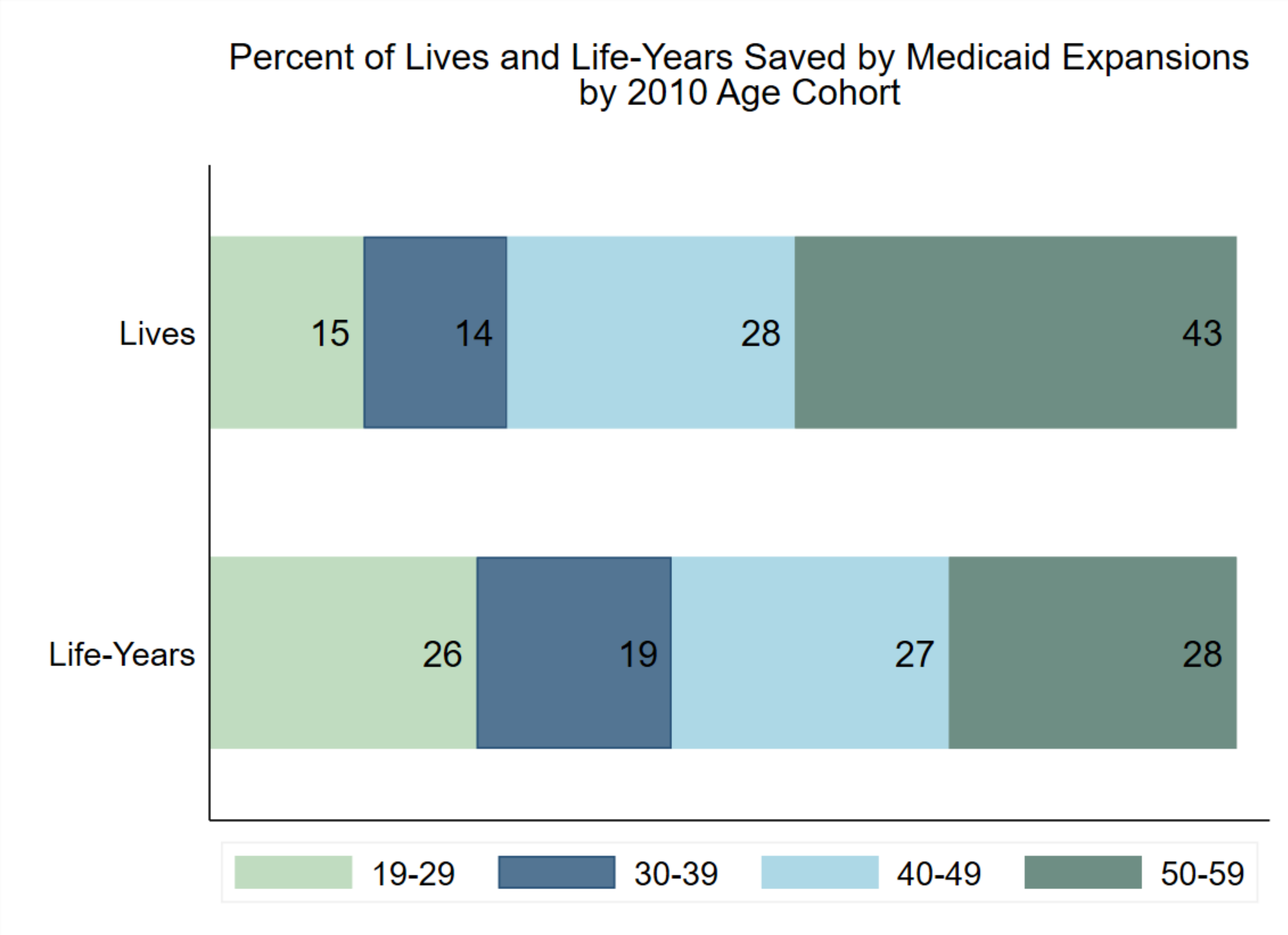


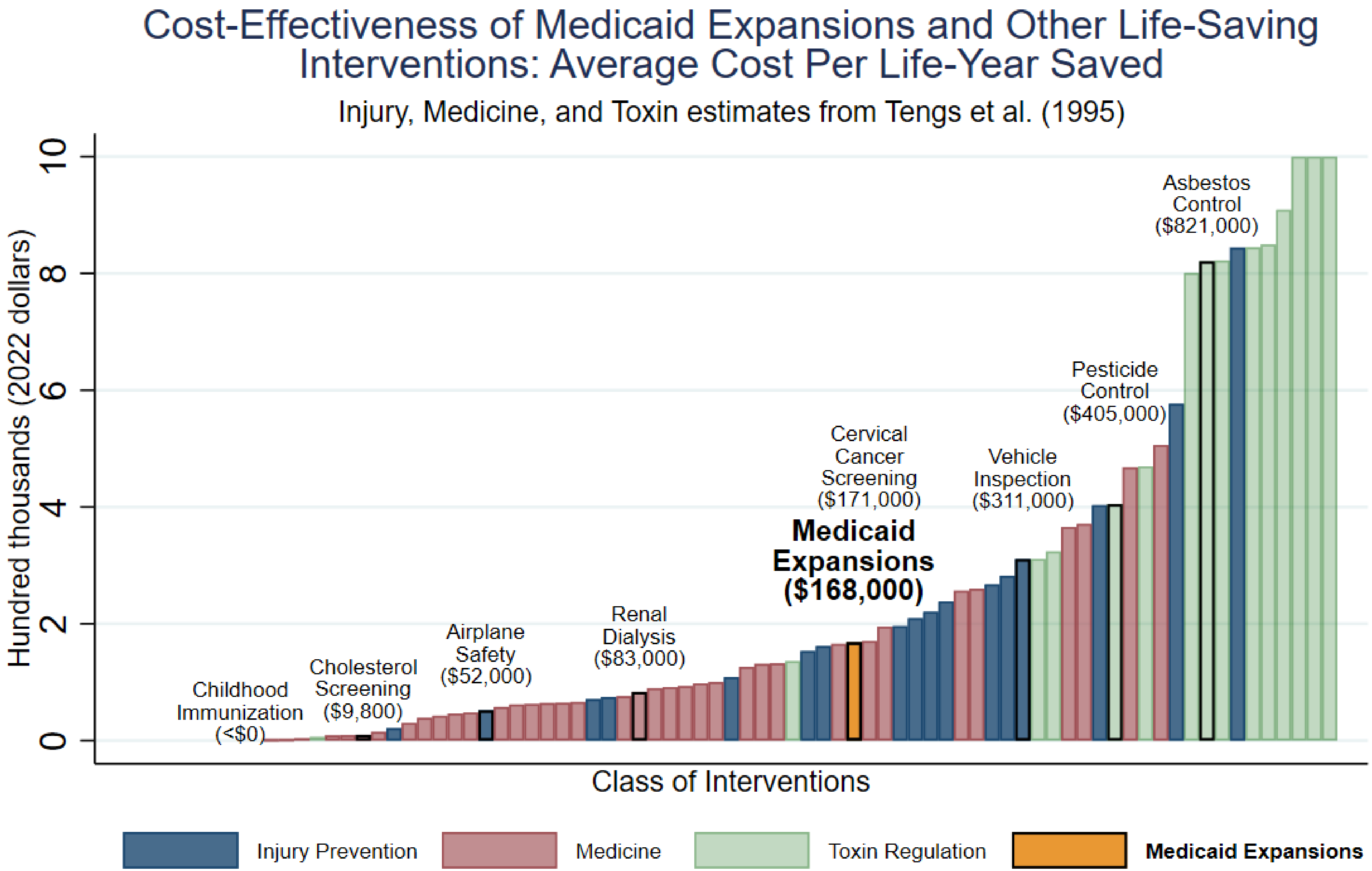
Sources: Compressed Mortality File 2000-2016 on CDC WONDER Online Database, released June 2017. Centers for Disease Control and Prevention, National Center for Health Statistics.

Interpreting the Magnitude and Cost-Effectiveness of Estimates

Our estimates suggest:

- **27,400 lives** and **890,000 life-years** were saved by Medicaid expansions between 2010 and 2022
  - Translates to **3,200 avoided deaths per year** in expansion states, close to the annual number of non-elderly deaths from HIV/AIDS
- **18,300** deaths in non-expansion states and an additional **7,100 deaths in expansion states** would have been avoided if all states had expanded in 2010
- The **cost per life saved** was about **$5.5 million**
  - Well below the $10-11 million value of a statistical life estimates used in federal government cost-benefit analyses
- The **cost per life-year saved** was about **$168,000**
  - Well below estimates of societal willingness-to-pay for additional life years of $283,000-400,000 from Braithwaite et al. (2008)


Percent of Lives and Life-Years Saved by Medicaid Expansions by 2010 Age Cohort
Lives
15
14
28
43
Life-Years
26
19
27
28
19-29
30-39
40-49
50-59



Note: Costs are top-coded at $1 million and bottom coded at $0. Bars indicate average cost per life-year saved across specific interventions within a given class of interventions, e.g. "Airplane safety" includes several types of fire-prevention interventions and floor lighting.

Spillovers

- Key assumption of treatment-on-the-treated estimates is no effect of Medicaid expansion on the mortality risk of those not induced to enroll in Medicaid due to the expansions, i.e. no spillovers
- Spillovers could be positive (e.g. increased investment in health infrastructure, prevention of rural hospital closures) or negative (e.g. diversion of resources to Medicaid patients)
  - Garthwaite (2012) finds that earlier Medicaid expansions to children decreased physician hours with a typical Medicaid patient but increased willingness to accept Medicaid patients
  - Einav et al. (2020) found evidence that Medicare payment reforms had similar effects on the health of treated and untreated individuals
- People residing in non-expansion states may have been induced to obtain insurance through subsidies for insurance purchase on ACA exchanges at higher rates than those in expansion states
  - Such an occurrence would likely attenuate our estimates of the effect of Medicaid on mortality, because it suggests the counterfactual to expansion is not no Medicaid, but some degree of insurance purchased through exchanges

Conclusions

Conclusions

- We estimate that Medicaid reduces the mortality risk of enrollees by about 21%, adding to a growing body of evidence that insurance, and Medicaid in particular, improves health
  - This reduction, while substantial, is smaller than less precise estimates reported in previous literature
- Unlike prior studies, our estimates are general to the entire population of potential beneficiaries under recent expansions and suggest health improvements for broad subsets of this population, not just older adults
  - While most lives saved are among older adults (40-59 in 2010), nearly half of life-years saved accrue to younger adults (19-39 in 2010), due to this latter group's longer life expectancies and greater representation in the low-income adult population
- Our estimates suggest a direct cost of $5.5 million per life saved and $168,000 per life-year saved, well below valuations of a life and life-year frequently cited in cost-benefit analyses