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DISCUSSION PAPER SERIES

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ISSN: 2365-9793

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# ABSTRACT

## Medicaid and Teen Suicide*

We examine whether increases in Medicaid coverage among teens reduced suicide risk. Youth are at elevated risk for depression but receive the least care. We exploit state-level variation in Medicaid coverage controlling for crowd-out to identify effects on risk for suicide. We build an age-group/state/year panel measuring suicide rates from CDC data and age-specific rates of insurance coverage from the American Community Survey. We estimate that among those between the ages of 15 and 19, suicide rates fell by 0.023 log points, or 1 percent of the mean with each 1 percent increase in the population of teens covered by Medicaid. This decline was larger for teens than any other group. We assess whether our TWFE estimated effect of a continuous treatment approximates an average causal response by comparing treatment effects at different margins. We form 47 treatment-control groupings of states changing key features of Medicaid enrollment policies in different years along with always/never treated states. Our treatment effects at these various margins are within confidence bounds for our average effects. We provide the first evidence on the role of public health insurance coverage on teen suicide in the U.S.

**JEL Classification:**

**Keywords:**

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* We benefitted from the comments of participants at the 12th Annual Workshop on the Economics of Risky Behavior in May 2023 and the 2023 ASHEcon and APPAM Annual Research conferences, as well as those of Brandyn Churchill, Catherine Maclean, and Belgi Turan. All interpretations and any errors are our own.

The suicide rate in the United States has risen by almost 40 percent since 2000 (U.S. CDC, 2022). In that year, 10.4 per 100,000 Americans died by suicide, but this figure rose to 14.1 per 100,000 by 2021.[1] During the first decade of the 21st century, the increase was driven primarily by rising suicide rates among prime-age adults, due in part to fall-out from the Great Recession (Marcotte & Hansen, 2023). Since the economic recovery took hold, suicide rates among those between the ages of 25 and 54 have mostly held steady. Unexpectedly, suicide rates among persons younger than 25 have increased dramatically during the same period.

This notable rise in suicide mortality among young Americans coincides with concerns about declines in well-being and mental health among children and adolescents. For example, a growing literature is attempting to disentangle the effects of social media and internet usage on a host of factors such as adolescent self-perception, sleep, relationships, depression, and bullying (Allcott et al., 2020; Braghieri et al., 2022; Janiri et al., 2020; Keles et al., 2020; Woods & Scott, 2016). Even as causes are not yet fully understood, it is clear that adolescent mental health has been declining in the U.S. since 2010.[2] Using the National Survey on Drug Use and Health (described below), we estimate that the fraction of adolescents with major depression rose from 8.2 to 15.7 percent between 2011 and 2019.[3]

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[1] Rates are age-adjusted, from https://www.cdc.gov/nchs/data/hus/2020-2021/SuicMort.pdf and https://www.cdc.gov/suicide/suicide-data-statistics.html.

[2] Corredor-Waldron & Currie (2023) suggest that some of the recent rise in mental illness among among teens is due changes in medical diagnostic coding and screening, related to self-harm, not entirely to rising incidence in the population. Nonetheless, the rise in suicide rates among teens makes clear the mortality cost of declining mental health among teens.

[3] Major depression is a clinical diagnosis codified in the American Psychiatric Association's Diagnostic Statistical Manual (DSM 5 TR). A person suffering from major depression experiences at least 5 symptoms for at least two weeks that cause substantial impairment and does not include a

Because this decline in mental health has coincided with recent increases in suicide rates among young people, and because mental illness is among the most important risk factors for suicide (Brown et al., 2000), reducing suicide mortality among young persons in the U.S. will likely require interventions to identify and treat mental illness. A recent review of determinants and prevention of suicide in the U.S. concluded that "…access to quality mental health care should be the first line of defense to reduce suicide" (Marcotte and Hansen, 2023).

In this paper, we study whether expansions of health insurance coverage reduce suicide mortality for teens.[4] To do this, we exploit differences in the rates at which states expanded public health insurance coverage and access among young persons to study effects on suicide risk.[5] Over the past 15 years, states have expanded access to Medicaid and implemented provisions of the federal Affordable Care Act (ACA). Consequently, insurance coverage has increased significantly (Miller & Wherry, 2017). This is because the expansion of publicly provided and mean-tested coverage via Medicaid has not been offset by a commensurate decline in private insurance, or crowd-out (Courtemanche et al., 2017). Although the ACA-

manic or hypo-manic behavior. The symptoms include but are not limited to: depressed mood, weight loss, insomnia or hypersomnia, diminished ability to think or concentrate, suicidal thoughts or planning (APA, 2022).

[4] We focus on teens aged 15-19 because detailed mortality data at the state year level are available for five-year age groups.

[5] Public health insurance options for teens include Medicaid and CHIP (Children's Health Insurance Program); Medicaid and CHIP provide free or low-cost health insurance to low-income people, families and children, pregnant women, elderly people, and people with disabilities (U.S. Centers for Medicare and Medicaid Services, n.d.-a). CHIP is available in all states to cover children whose families make too much money to qualify for Medicaid. Medicaid and CHIP follow federal guidelines; however, costs and coverage vary by state. In 2021, 35.9% of children were covered by Medicaid or CHIP, and as of February 2023, nearly 42 million children were covered by either Medicaid or CHIP (*February 2023 Medicaid & CHIP Enrollment Data Highlights*, 2023; Mykyta et al., 2022).

induced Medicaid expansions directly targeted low-income adults, the expansions also led to increases in coverage among children through what are referred to as welcome-mat effects (Hudson & Moriya, 2017). During this same period, states also implemented policies to make it cheaper or easier for residents to enroll in Medicaid, including eliminating premiums and copayments and allowing online renewal of coverage. As further motivation that health insurance coverage may impact suicide, during our study period, Medicaid and CHIP are required to cover mental health services (U.S. Centers for Medicare and Medicaid Services, n.d.-a, b).

We examine whether the resultant expansion of public health insurance coverage reduced suicide risk among young persons. We focus on the effect of health insurance coverage on young persons relative to prime age adults for several reasons. First, uninsurance rates for young adults have historically been higher than other groups, and prior to recent Medicaid expansions, uninsurance rates for children between the ages of 6 and 18 were high (10.6 percent in 2008).[6] Second, teens are at especially high risk of depression, the most significant risk factor for suicide (Brown et al., 2000). Using data from the National Survey of Drug Use and Health, Marcotte and Hansen (2023) estimate that 8.1 percent of 12- to 17-year-olds had experienced an episode of major depression in 2009. This is compared to 5.2 percent of 18- to 25-year-olds, 4.8 percent of 26- to 49-year-olds, and 2.6 percent of those over 50.

[6] SHADAC analysis of ACS PUMS. State Health Compare, SHADAC, University of Minnesota, statehealthcompare.shadac.org, Accessed May 1, 2023.

Survey estimates from the NSDUH also found that teens had the lowest rate of treatment among those with depression: 34.6 percent of teens with major depression reported treatment in 2009, compared to 64.8 percent of adults (Marcotte and Hansen, 2023). So, for teens and young adults, gaining health insurance coverage could have relatively large effects on mental health treatment and reductions in suicide risk. In addition to lack of health insurance and access to mental health services, teens have lower levels of treatment due to lack of knowledge about mental illness, perceived and experienced stigma, and hesitancy to disclose symptoms or disease (Moses, 2009). Adolescents are reluctant to share their mental health struggles with their parents and are more likely to disclose mental health concerns in an interview when parents are not present (Herrera et al., 2017). Additionally, fear of asking for help, preference for self-management, and stigma are other reasons for lower levels of treatment among adolescents (Sheppard et al., 2018). In a qualitative study, Rasmussen et al. (2022) identified five themes in teens' decision making that reduce chances of disclosing mental health problems to their parents: their own mental health literacy, perceived empathy of parents, fear of negative response, perception of parent-child relationship, and perception of the severity of their mental illness.[7]

Our paper contributes to a growing literature on the effects of Medicaid expansions on mental health. Medicaid expansion has increased utilization of mental healthcare (Breslau et al., 2020; Blunt et al., 2020;Ortega, 2023), but there

[7] This study should be interpreted cautiously, as 90% (27 out of 30) of respondents were White.

is mixed evidence on whether Medicaid expansion has reduced suicide risk. Austin et al., (2021) and Patel et al., (2022)) report relative declines in suicide rates among adults in expansion states. However, Ortega (2022) estimates that Medicaid expansion led to a decrease in suicide rate among some groups, but not the overall adult suicide rate and Maclean et al. (2018) also find no effect of Medicaid expansion on adult suicide rate. However, there has been no work on the impact of Medicaid expansion on the group whose rates of suicide risk are growing fastest – young persons.

To assess whether Medicaid and CHIP coverage slowed the rise in suicide rates for young persons, we combine vital statistics data from the Centers for Disease Control and Prevention and rates of insurance coverage from by age group from the American Community Survey to build a panel data set for 5-year age groups in each state/year from 2009 through 2021. We also include data on a variety of controls for poverty, unemployment, and demographic characteristics of each group/state/year cell estimated from the U.S. Bureau of Labor Statistics and the Census Bureau.

Using this panel data set, we estimate a series of two-way fixed effects (TWFE) models to identify the impact of within-state changes in Medicaid/CHIP coverage on suicide rates for teens and young adults over and above any changes during the same period for other age groups or youth in other states. Our two-way models identify treatment effects if changes in Medicaid/CHIP coverage for teens and young adults are conditionally independent of other factors affecting suicide

risk for these groups relative to older residents. We estimate that among those between the ages of 15 and 19, suicide rates fell by 0.023 log points with each 1 percent increase in the population of teens covered by Medicaid/CHIP. This decline is 1 percent of the mean suicide rate for 15–19-year-olds. The decline in suicide rates with the increase of coverage was larger for teens than any other group.

In TWFE models, estimates of the effects of a continuous treatment like ours include weighted averages of treatment effects across different levels of treatment and treatment years, as well as different levels of selection bias at those treatment margins (Callaway et al., 2021; deChaisemartin et al., 2023). Unlike the dichotomous treatment effect case, there is no ready solution. First, rather than a fixed number of underlying 2x2 estimands, there are infinite treatment margins. Second, it is plausible that selection bias into treatment levels varies across those margins, making it all but impossible to test identifying assumptions.

To address these complications, following recommendations from Callaway et al. (2021) we estimate treatment effects without TWFE, and compare treatment effects at different margins. Our results are remarkably consistent, suggesting that the TWFE estimates an average treatment effect relevant across multiple settings. We believe this paper provides the first compelling evidence on the role of public health insurance coverage and access on teen suicide in the U.S. We conclude by discussing implications for access to behavioral health care as means to reduce suicide rates.

## Background

*Trends in Depression and Suicide among Teens*

Major depressive disorder is the most significant risk factor for suicide (Brown et al., 2000), and rates of depression are high and have been rising for teens. To illustrate the rise in depression among teens, in Figure 1 we plot rates of major depression over time, by age group. We use data from the National Survey of Drug Use and Health which administers the Composite International Diagnostic Interview (CIDI) to estimate rates of depression and other mental illnesses in the 12 months prior to interview. A major depressive episode is experiencing at least one period of 2 weeks or longer when for most of the day nearly every day, one feels depressed or has lost interest and pleasure in daily activities; it also includes experiencing problems sleeping, eating, energy, concentration, self-worth, or having recurrent thoughts of death or suicidal ideation (Substance Abuse and Mental Health Services Administration, 2022). Teens are at especially high risk for depression, with about 8 percent experiencing a recent major depressive episode in 2010. However, beginning in 2012, the likelihood a young respondent had recently experienced major depression started to climb, dramatically. The percent of teens with major depression nearly doubled from 8.2 in 2011 to 15.7 by 2019. The relative increase was even larger among young adults aged 18 to 25, with the percent of respondents suffering from depression effectively doubling from 5.2 to 10.3 over the same period. The rise in risk for depression among the young is stark in comparison to older Americans. For respondents between the ages of 26 and 49, prevalence of

major depression increased modestly over this period, and the likelihood of having depression did not increase at all over the period for those over 50.

Second, teens and young adults who suffer from depression have the lowest rates of treatment of all age groups (Goodwin et al., 2022). In Figure 2, we graph trends in the likelihood of receiving treatment or counseling among those with major depression, by age group. The graph makes clear that the rate of treatment rises with age, and the youngest groups are least likely to receive treatment. For teens, only 38.4 percent of those with major depression reported counseling or therapy in 2011, and this increased to 43.3 percent by 2019. For young adults aged 18 to 25 over this period, the receipt of therapy or counseling went from 47.9 to 50.9 percent. Persons older than 26 were more likely to receive treatment overall but saw no substantial changes over the same period.[8]

Because of the high levels of depression and low levels of treatment, expanding access to mental health services has been identified as a first order strategy for reducing suicide (CDC, 2022a). In this paper, we estimate the effect of increases in teen public health insurance coverage on teen suicide rates in the U.S. During the past two decades there have been notable but uneven adoption and implementation of policies that impact accessibility and coverage of mental health care. Enacted beginning in the 1990s, major policies include mental health parity laws and the Affordable Care Act. Mental health parity laws are implemented at

[8] See "Key Substance Use and Mental Health Indicators in the United States: Results from the 2021 National Survey on Drug Use and Health" for a more detailed discussion of depression and mental health service use trends.

the state and federal level prior to the start of our study period in 2009; however, the most recent federal parity legislation took effect in 2010. And provisions of the Affordable Care Act took effect in multiple years of our study period, most notably 2010 and 2014 through 2020.

*Mental Health Parity Laws*

Attempting to reduce financial inequities between physical and mental health care, mental health parity laws attempt to ensure that services related to mental health and substance use are covered by health insurance plans at rates comparable to that of physical health services.[9] To this end, these laws typically mandate that financial requirements (e.g. deductibles, copayments, coinsurance, and out-of-pocket maximums), and treatment limits (e.g. day and visit limits) or other limits for mental health benefits cannot be more restrictive than those on medical and surgical benefits (Pestaina, 2022; U.S. Centers for Medicare and Medicaid Services, n.d.-c).

Mental health parity laws reduce financial barriers to mental health treatment and thereby should decrease financial burden and increase service use. However, the evidence of the impact of mental health parity laws on financial burden and service use is mixed, with net effects differing by when the laws were implemented (early vs. recent parity laws) and by the level at which the law was implemented (state vs. federal). Overall, recent reviews of the mental health parity

[9] Physical health and medical and surgical health are used interchangeably to refer to non-mental health related services.

literature conclude that parity has not led to significant increases in service utilization and expenditures (Barry et al., 2016; Peterson & Busch, 2018).[10]

Most of the mental health parity literature focuses on adherence to parity requirements and impact on service use and out-of-pocket spending, but relevant to this paper, two studies examine the impact of mental health parity laws on suicide ((Barry et al., 2016; Klick & Markowitz, 2006; Lang, 2013). Klick & Markowitz (2006) and Lang (2013) investigate the impact of state mental health parity laws on adult suicide rates. Using data from 1980 to 2000, Klick & Markowitz (2006) find no effect of mental health parity laws on suicide. Lang (2013) finds that mental health parity laws reduce adult suicides by 5% using later data.[11] These findings suggest that further research is needed on the relationship between health insurance and mental healthcare and suicide.

*The Affordable Care Act*

Beyond changes in parity requirements, there have been important changes in the policy landscape to increase health coverage, generally. The Patient Protection and Affordable Care Act, passed in March 2010 and commonly referred to as the ACA, is a comprehensive health care reform law that aimed to increase health insurance coverage in the U.S. The ACA included mental health and substance use disorder services as essential health benefits that must be covered by

[10] For a more detailed summary of the history of mental health parity legislation and the literature, refer to "Federal Parity In The Evolving Mental Health And Addiction Care Landscape" (Barry et al., 2016) and to "Achieving Mental Health and Substance Use Disorder Treatment Parity: A Quarter Century of Policy Making and Research" (Peterson & Busch, 2018).

[11] The difference in findings is likely due to different study periods, with an additional 20 states implementing parity laws between the periods of the earlier and later study.

small group and individual private health insurance plans, including those purchased on state marketplaces; similarly, the ACA also extended parity requirements to these plans. Approximately 11 million people were affected by the parity requirements for individual health insurance plans (Peterson et al., 2018).

The ACA also increased access to mental health services by expanding health insurance coverage. In 2014, states began expanding their Medicaid programs to cover low-income adults (aged 19-64 with incomes at or below 138% FPL); Medicaid expansions are enacted at the state level due to a 2012 Supreme Court ruling that the Act was unconstitutionally coercive of states (Musumeci, 2012). Although low-income adults were the targeted population of the Medicaid expansions, insurance coverage for children rose correspondingly (Hudson & Moriya, 2017). This systematic increasing of eligibility for Medicaid is commonly referred to as the "Medicaid expansions."

The effects of the ACA-induced Medicaid expansions on mental health treatment and outcomes have received a fair amount of attention in the literature. Studies find that Medicaid expansion increased mental healthcare utilization among nonelderly adults and college students, which includes increased psychotropic prescriptions (Cowan & Hao, 2021; Ghosh et al., 2017; Maclean et al., 2017; Ortega, 2023; Blunt et al., 2020; Breslau et al., 2020). Medicaid expansion also led to increases in admissions to mental health facilities and mental health-related outpatient visits (Breslau et al., 2020; Ortega, 2023). On the supply side,

Blunt et al. (2020) find that Medicaid expansion led to an increase in the probability that a mental health provider accepts Medicaid.

A few studies have analyzed the impact of Medicaid expansion on adult suicide risk. Austin et al., (2021) estimate that suicide rates in expansion states fell by 1.2 suicides per 100,000 population (18-64 year olds) relative to non-expansion states, and Patel et al., (2022) estimate the decline for non-elderly adults at 0.4 per 100,000 population. Both papers use a difference-in-differences framework, but different time periods and treatment/control states.[12] Ortega (2022) finds a decrease in suicide rate among male, Black, and White adults as an effect of Medicaid expansion; however, the paper finds no effect on the overall adult suicide rate. Maclean et al. (2018) also find no effect of Medicaid expansion on adult suicide rate using a study period from 2011-2016.

As far as we know, there has been no work on the impact of Medicaid expansion on youth suicide. The nearest evidence comes from studies that examine the correlation between the mental health care workforce and youth suicide rates. Hoffmann et al., (2023) find that county designation as a mental health workforce shortage area is associated with an increased youth suicide rate using data from 2015 and 2016. And Goldstein et al., (2022) find that a 10% increase in a state's mental health workforce capacity is associated with a 1.35% decrease in the non-firearm suicide rate for 10–24-year-olds using data from 2002-2017. Neither of these

[12] Austin et al. (2021) include 8 expansion states and 7 non-expansion states and have a study period of 2005-2017, whereas Patel et al. (2022) include all states and have a study period of 2000-2018.

papers examine the causal relationship between health insurance coverage, particularly Medicaid, and youth suicide.

**Data**

To estimate the impact of Medicaid coverage on teen suicide rates, we use data from a variety of sources. We construct an age group/state/year panel data set from 2009 to 2021 that includes suicide rates, health insurance coverage rates by type of coverage, and demographic controls. Suicide rate data come from the Multiple Cause-of-Death Public Use Mortality Files from the Centers for Disease Control and Prevention (CDC). We collect mortality data for teens and adults from 15 to 64 years old, by 5-year age groups in a state year from 2009 to 2021. We measure suicide rates by 5-year age groups because of problems with cell size for single-year age groups due to data suppression required for confidentiality protection. Because suicide rates in age/state cells are positively skewed, we use log suicide rates in our analyses. This data is a balanced panel with observations for each age group cell in every state in every year in our study period.

We use data from the American Community Survey (ACS) from 2009-2021 to measure rates of health insurance coverage by type for each of the 5-year age group/state/year cells. We collected rates of coverage by type: employer-sponsored private, Medicaid or CHIP, Medicare, and insurance through the VA, Tricare, or Indian Health Services. We also include controls of state/year population characteristics from the ACS, including educational attainment, demographic

composition, and the proportion of the population living in poverty. We include age group, year, and state fixed effects, and cluster standard errors on the state level.

We collect data on public policies affecting Medicaid enrollment for adults and children.[13] All of our data on health insurance-related public policies come from the Kaiser Family Foundation (KFF). These include Affordable Care Act-induced Medicaid expansions from 2014-2020. We also compiled data on other measures of accessibility and cost of public health insurance from annual reports on state Medicaid and CHIP programs from the KFF Program on Medicaid and the Uninsured from 2009 to 2020.[14] This includes information on whether a state has a child waiting period for Medicaid enrollment, enrollment and renewal procedures, and cost-sharing practices, such as whether a state requires any copayment for children, for non-preventative physician visits, ER visits, inpatient hospital stays, and generic prescriptions.

**Methods**

Using these data, we estimate models to measure the relationship between public health insurance coverage and suicide rates. We first estimate the effect of changing health insurance coverage rates on suicide mortality, net of age group and state and year fixed effects:

$$(1) \qquad S_{gst} = \alpha + X_{st}\beta + \delta I_{gst} + \mu_g + \mu_s + \mu_t + \epsilon_{sgt}$$

[13] Some of the policy changes described below affect children separately from adults, so have an effect on 15-17 year olds, but not 18-19 year olds. Others effect those under 26, so affect all teens, but also those aged 20-25. As we note above, we focus on 5-year age groups (e.g. 15-19 and 20-24 year olds) because of data limitations.
[14] No report was issued in 2014.

Where $S_{gst}$ is the log suicide rate for age group $g$ in state $s$ in year $t$. $X_{st}$ is a vector of state level conditions that are related to population health and suicide risk. These include the state unemployment rate, poverty rate, and characteristics of the population, including gender and race composition and educational attainment. $I_{gst}$ is our measure of the percent of those covered by Medicaid in group $g$ in state $s$ in year $t$ we estimate from ACS data. We also include a measure of the proportion of those covered by any health insurance to control for possible crowd-out. So, the coefficient of interest ($\delta$) is a weighted average of changes in group-specific suicide rates as Medicaid coverage rates increase, net of state fixed effects ($\mu_s$) and year fixed effects ($\mu_t$). We also include age group fixed effects ($\mu_g$) because suicide rates vary by age.

The two-way fixed effect (TWFE) model above estimates changes in suicide rates at the state level as health insurance coverage for that group increases, over and above changes experienced during the same period in other states where Medicaid coverage grew less. This model estimates average changes in suicide risk across all age groups within a state. Since some policies to expand Medicaid coverage were targeted at children, and for the reasons described above, we hypothesize that effects will be largest for teens and young adults. Consequently, we augment our TWFE model to allow for different effects of increasing Medicaid coverage for different age groups:

$$S_{gst} = \alpha + X_{st}\beta + \sum_{g} \delta_g I_{gst} + \mu_g + \mu_s + \mu_t + \epsilon_{sgt} \quad (2)$$

Model 2 estimates the impact of increasing Medicaid coverage on suicide rates by age group. The identifying assumption of this augmented age group-state-year fixed effects model is that group-specific changes in Medicaid coverage are unrelated to other changes in a state that shapes population health and well-being. In a TWFE model like this, where the treatment variable is continuous, interpreting the average treatment can be less than straightforward. As in the dichotomous treatment effect case, the estimated treatment effect here is a weighted mean of outcome differences between units receiving different treatment doses at different times (Callaway et al. (2021); deChaisemartin et al. (2023)). Further, the parallel trends assumption is now generalized across levels of the continuous treatment variable for marginal movers ($\frac{\partial I}{\partial t} \neq 0$) compared to marginal stayers for all levels of treatment and years. Callaway et al. (2021) illustrate that the average treatment effect estimated in a TWFE model like the one above includes weighted averages of treatment effects across different levels of treatment, but also different levels of selection bias at those treatment margins.

While there is no easy solution here, we implement several extensions suggested by Callaway et al. (2021) to assess whether the coefficient estimated in our TWFE model can be interpreted as an average causal response. These include avoiding TWFE altogether. So, in our main set of results, we include models with and without state and year fixed effects. Callaway et al. (2021) also suggest that insight into the potential of differential selection bias to confound interpretation can

be gotten by comparing treatment effects at different treatment margins. We discuss and implement these extensions in a robustness section, below.

**Results**

We present summary statistics for our state-year panel data in Table 1. In terms of demographics, the population of the average state/group/year was 69 percent non-Hispanic White, 10.9 percent non-Hispanic Black, and 11.4 percent Hispanic. Overall, the average state's population had an equal proportion of high school graduates and dropouts (about 30 percent), while 19 percent and 21.5 of the population had attended some college or graduated college, respectively. The average poverty rate was 16.3.

Over the entire study period, the average rate of insurance coverage was 86.34 percent, with a standard deviation of 8.07. Private insurance was the most common type of coverage (70.5 percent), and the majority of this (59.4 percent) was sponsored/subsidized by an employer or union. In the average state, 11.7 percent of respondents purchased insurance directly on the open market, including through state coordinated marketplaces. On average, 15.13 percent of the population was enrolled in Medicaid, and 8.3 percent was enrolled in Medicare.

*TWFE Results*

We turn to the results from our two-way fixed effects models in Table 2. In the first two columns, we present results from our first model of the aggregate effect of Medicaid coverage on suicide rates for all groups. In Column 1, we present results from Model 1, our group average TWFE estimate. For comparison, in Column 2, we

replace year fixed effects with group specific linear trends, since suicide rates followed different patterns for different age groups over the period. Regardless of how we control for underlying changes over time, we estimate that log suicide rates fell as Medicaid coverage increased within states by the same magnitude in Columns 1 and 2, and in both cases, the coefficient is statistically indistinguishable from zero.

In Column 3, we present the results from the more flexible TWFE model that estimates age group specific responses to changes in Medicaid coverage (Model 2, above). As is clear, suicide rates fell most for the youngest age groups: We estimate that among those between the ages of 15 and 19, suicide rates fell by 0.023 log points with each 1 percent increase in the population of teens covered by Medicaid. To interpret this magnitude, consider that for this group the dependent variable mean was 2.39 with a standard deviation of 0.48. The mean Medicaid coverage rate was 25.7 (s.d. = 6.98). So, an increase in Medicaid coverage of 1 percent is an increase of about 4 percent (or 0.15 s.d), and this leads to a decline in suicide mortality of about 1 percent of the mean, or about 0.05 standard deviations.

The effect of increasing Medicaid coverage for young adults between the ages of 20 and 24 is also negative and significant, but about one-third the size of the effect seen for teens. For young adults, a one percent increase in Medicaid coverage leads to a decline in suicide mortality of 0.007 log points – about 0.25 percent of the mean. For this group, Medicaid coverage is low, about 12 percent on average. A 4 percent increase in coverage rates (almost a full standard deviation) would reduce

suicide mortality by about one percent. We see no significant changes in suicide mortality as Medicaid coverage increases for those between the ages of 25 and 45.

For older groups the results are mixed. Among those between the ages of 45 and 55, we estimate a rise in suicide rates with increases in Medicaid coverage, while for the oldest group we estimate a decline. In both instances, the magnitudes are much smaller than observed for teens. For example, among 45- to 55-year-olds suicide rates increase by 0.006 log points for each one percent increase in Medicaid coverage. The magnitude here is about a quarter of that seen for teens, and the sign is unexpected. For older adults, Medicaid enrollment is often due to disability, so this may be associated with underlying declines in population health.

*Robustness Checks*

There is no direct path toward interpreting coefficients on continuous measures of treatment, such as those in column 3 of Table 2, as average causal effects. A first and simple comparison suggested by Callaway et al. (2021) is to compare TWFE estimates from those obtained without time and group fixed effects. Estimates of treatment effects across units and time necessarily rely on a different treatment margin – comparing between rather than within unit variation in exposure and outcomes. In column 4 of Table 2, we omit state and year fixed effects. Relying on variation in Medicaid coverage over space for different age groups, we estimate differences in suicide mortality that is identical to the effect estimated in our TWFE model for youth (-0.023 for 15- to 19-year-olds and -0.007 for 20- to 24-year olds).

To further assess the interpretation of our TWFE estimates from Table 2, we re-estimate treatment effects at different treatment margins (Callaway et al. (2021)). To identify relevant margins, we re-estimate our model of Medicaid coverage on age-group specific changes in suicide mortality (Model 2) in different "experimental" settings. The strategy is related to deChaisemartin et al. (2023), who illustrate that under parallel trends assumptions, potential outcomes for units that "switch" can be obtained to estimate treatment effects relative to "stayers," where switchers are units where values of the continuous treatment change, relative to "stayers" with comparable baseline levels of treatment, but no change over the period.

To establish salient switcher/stayer groupings, we compiled data on changes in key discretionary policy choices made by states over our panel. Using the KFF Program on Medicaid and the Uninsured data, we identify eight dichotomous policy choices states implemented at different times, or not at all. These include 1) expanding Medicaid per the ACA, 2) requiring a copay for an ER claim, 3) requiring a copay for a general practitioner claim, 4) requiring a copay for an inpatient hospital stay, 5) requiring a copay for prescription drugs, 6) 12-month continuous eligibility, 7) online renewal, and 8) requiring a waiting period between enrollment and coverage for children. Each of these policies has the potential to expedite or impede enrollment in Medicaid. Because they differ in timing of implementation, they set up numerous potential comparisons, such as early adopters versus late or never adopters. Since states implementing these policy/timing combinations vary in

means and rates of change in Medicaid enrollment, they provide different quasi-experimental contexts in which to estimate the effect of Medicaid expansion on suicide. If the estimates vary with setting, this would undermine the case for interpreting our main TWFE estimates as a causal average treatment effect.

Rather than focus on the full set of policy changes, we first identify the most important policies affecting changes in Medicaid enrollment within states. We model group-specific changes in Medicaid coverage (our primary independent variable, above) as a function of our demographic and economic controls, age-group, state, and year fixed effects, and each of these eight dichotomous policy measures. To identify the most important policy changes from this set, we use the Least Absolute Shrinkage and Selection Operator (LASSO). We implement three separate LASSO regressions: The first and second use the Aikake Information Criterion (AIC) and Bayesian Information Criteria (BIC) for cross-validation, respectively. The third is an adaptive LASSO that avoids overfitting (Zou, 2006).

We summarize the result of our LASSO estimates in Table 3. Each column reports coefficients on state policy measures to predict Medicaid enrollment rates for age/year/state cells. Each model controls for state demographic and economic measures and state, year and age group fixed effects (as in Model 1). The first column reports coefficients from a regression of Medicaid enrollment rates on all control variables from Model 1 and the eight policy measures obtained from KFF. Columns 2-4 report LASSO-selected coefficients using the AIC, BIC, or adaptive regularization penalties, defined in the column head. Across all models,

implementation of the ACA was the single most important determinant of Medicaid enrollment change. We estimate that the enrollment increased by over 3 percentage points for the typical age group in the year following expansion.[15] We also estimate that requiring co-pays for prescription drugs and waiting periods for children's coverage both moderately reduce Medicaid enrollment, while permitting online eligibility determination is associated with expanded coverage.

The policy changes identified as most predictive of Medicaid enrollment changes in at least two of the three LASSO regularization methods were: 1) Medicaid expansion, 2) online renewal, 3) child waiting periods between enrollment and coverage, and 4) requiring a copay for prescription medication. In Table 4, we provide details on the states that implemented or dropped each of these four policies during our panel; we also include the states that always/never had relevant policies in place.

The four predictive dichotomous policy changes over our panel set up 47 different settings to test effects of Medicaid enrollment changes for "switchers" relative to "stayers" over the same period. For online renewal and prescription co-pays, we distinguish between stayers that never implement those policies during our panel, and those where they are always in effect. In Table 5, we summarize the TWFE estimates for states implementing the ACA requirements (i.e., Medicaid

[15] Our estimate is similar to the increase in insurance coverage for children following the first year of ACA Medicaid expansions (Hudson and Moriya, 2017). Our estimate is smaller relative to another study, Soni, Hendryx, and Simon (2017), that finds about an 8.7 percentage point increase in the probability of childless adults having Medicaid and a 6.7 percentage point increase in the probability of any adult having Medicaid.

expansion), by year of expansion. Each column presents results from separate regressions where the samples are restricted to states expanding Medicaid under the ACA in the relevant year, or states that never expanded under ACA by 2020.

Our TWFE estimate of Medicaid coverage on suicide rates comparing only states that expanded Medicaid in 2014 and never-treated states is -0.024 for teens, and -0.007 for persons between 20 and 24. Estimates from models comparing later switchers are slightly larger (-0.025 to -0.028 for teens and -0.011 to -0.013 for 20-to-24-year-olds). These estimates are comparable to the average TWFE from the full sample: -0.023 for teens and -0.007 for 20- to 24-year-olds.

Next, we replicate this analysis for the three other policy changes predicting intertemporal Medicaid enrollment changes. Unlike Medicaid expansion, states adopted and ceased policies like online enrollment and prescription drug copays over our panel. Also, unlike Medicaid expansion, in addition to never-treated states, there are always-treated states. As a result, for these policies there are potentially four sets of quasi-experimental groups – samples restricted to adopting states and never-treated states, and then adopters and to always-treated states. Similarly, we compare effects in states dropping policies like waiting periods to never- and always-treated states.

For ease of interpretation, we present the full set of results of separate estimates of Medicaid coverage effects on suicide in Appendix Tables A1, A2, and A3, but present the coefficients of interest graphically. Figure 3 reports coefficients for 15–19-year-olds from each of the dichotomous policy changes and relevant

treatment/control sample restrictions across all years. The figure presents coefficient estimates of the effect of Medicaid expansion on teen suicide rates at different margins of policy changes and years. We include the estimate and 95% confidence interval from our average TWFE estimate in Table 2 as reference.

Markers in black indicate estimates obtained from states implementing a policy that expanded Medicaid enrollment (e.g. revoking an existing waiting period). Markers in red indicate estimates samples with states implementing a policy that restricted Medicaid enrollment (e.g. implementing a waiting period). Filled markers indicate the sample also includes states that were never-treated (e.g. did not revoke a waiting period). Hollow markers indicate the sample included always-treated states (e.g. never had a waiting period). The x-axis indicates the year in which the relevant policy change was made. For example, the filled black diamond in 2010 is the estimated effect of expanded Medicaid enrollment for 15-19 year olds on suicide rates for the sample restricted to states that revoked a waiting period in 2010 or that had a waiting period in all years. Later-treated states are excluded, and black diamonds in other years are estimates from samples restricted to those states compared to never-treated states.

As is clear in Figure 3, TWFE estimates of the effect of expanded Medicaid coverage for 15-19 year olds on suicide rates from all policy treatment/control settings are largely within the confidence interval of the overall TWFE estimate from Table 2. There is no evidence that point estimates vary in any systematic way in samples restricted by different combinations of discretionary Medicaid policies.

The consistency of these parameter estimates strengthens the case for interpreting our main TWFE estimates as a causal average treatment effect.

We present the results for all other age groups in Appendix Figures A1-A9. The same pattern is observed across age groups. Estimates obtained at different policy treatment margins are overwhelmingly within confidence intervals for average treatment effects. Across policy contexts and years, there are small but significant reductions in suicide mortality with Medicaid enrollment for 20–24-year-olds with Medicaid expansion, along with those between the ages of 60 and 64. For other groups, effects cannot be distinguished from zero.

**Discussion**

Suicide rates for youth and young adults aged 10-24 years old have increased over 52% from 2000 to 2021 (Centers for Disease Control and Prevention, 2022b). Depression, depressive symptoms, and other mental illnesses are among the most important risk factors for suicide. Consequently, the comprehensive suicide prevention strategy recommended by the U.S. CDC calls for improving access and delivery of mental health care, which includes ensuring parity in coverage for mental health conditions and increasing provider availability in underserved areas (Centers for Disease Control and Prevention, 2022a, 2022c). Over the past decade, the ACA-induced Medicaid expansions have expanded insurance coverage and subsequently reduced costs and increased access to mental health care. Studies examine the relationship between Medicaid expansions and mental health care

utilization and suicide rates among adults and find generally that mental health care utilization increases and adult suicides decrease or do not change ((Austin et al., 2021; Maclean et al., 2017; Ortega, 2023; Patel et al., 2022).

In this study, we construct an age group/state/year panel dataset from 2009-2021 and estimate the impact of changes in Medicaid coverage rates on suicide rates using TWFE models with a particular emphasis on age-group specific effects. We find relative declines in the rate of growth in teen suicide in states where teen Medicaid coverage increased. We estimate that among those between the ages of 15 and 19, suicide rates fell by 1 percent of the mean suicide rate with each 1 percent increase in the population of teens covered by Medicaid. We also find a significant decrease in suicides for young adults aged 20-24. For young adults, a one percent increase in Medicaid coverage leads to a decline in suicide mortality of 0.007 log points – about 0.25 percent of the mean. Results from our TWFE models are consistent with estimates from models excluding fixed effects and models restricting treatment and control groups to evaluate effects at different treatment margins. Taken together, our results suggest that health insurance coverage plays a protective role in reducing teen suicide and behavioral precursors.

Our estimates of the impact of Medicaid expansion on teen suicide deaths are comparable to estimates for adults. Recent papers by Patel et al. (2022) and Austin et al. (2021) estimate that Medicaid expansion reduced adult suicide by 0.4 and 1.2 fewer deaths per 100,000. Our estimates imply a decline in teen suicide rates due to

Medicaid expansion of 0.5 fewer deaths per 100,000.[16] Using the ACS, we estimate that there are 21.6 million 15-19 year olds in the U.S. and approximately 1.7 million of this group remain uninsured. Our estimates suggest that expanding public health insurance to cover those who remain uninsured would reduce the number of 15-19 year olds who die by suicide by 175 per year.[17] This reduction in suicide mortality would of course be in addition to the direct health benefits due to expanded health insurance coverage.

[16] Medicaid coverage rates increased on average by 5 percent among teens in over the period, and suicide rates for this group average 10 per 100,000.
[17] In the last year of our panel, 2,178 15–19-year-olds died by suicide. Our estimates suggest a 1 percent decline in suicides for each percent increase in Medicaid coverage of teens.

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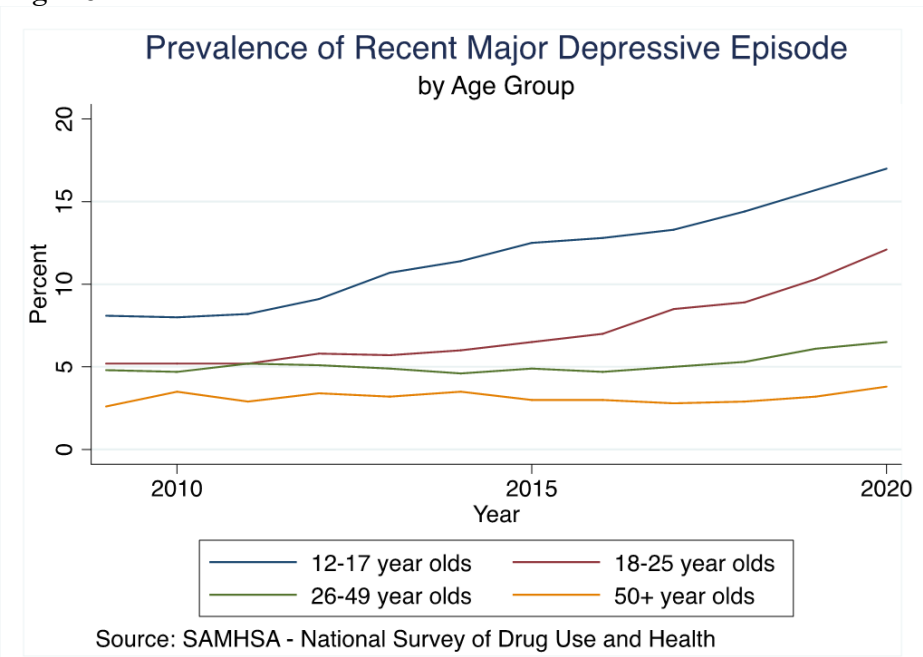
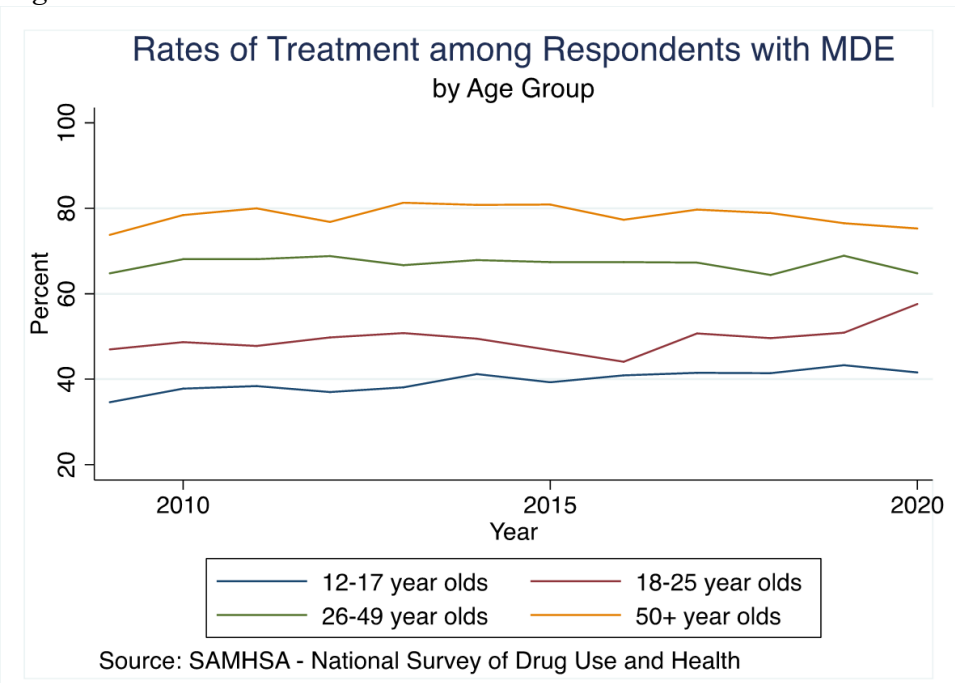
Figure 1



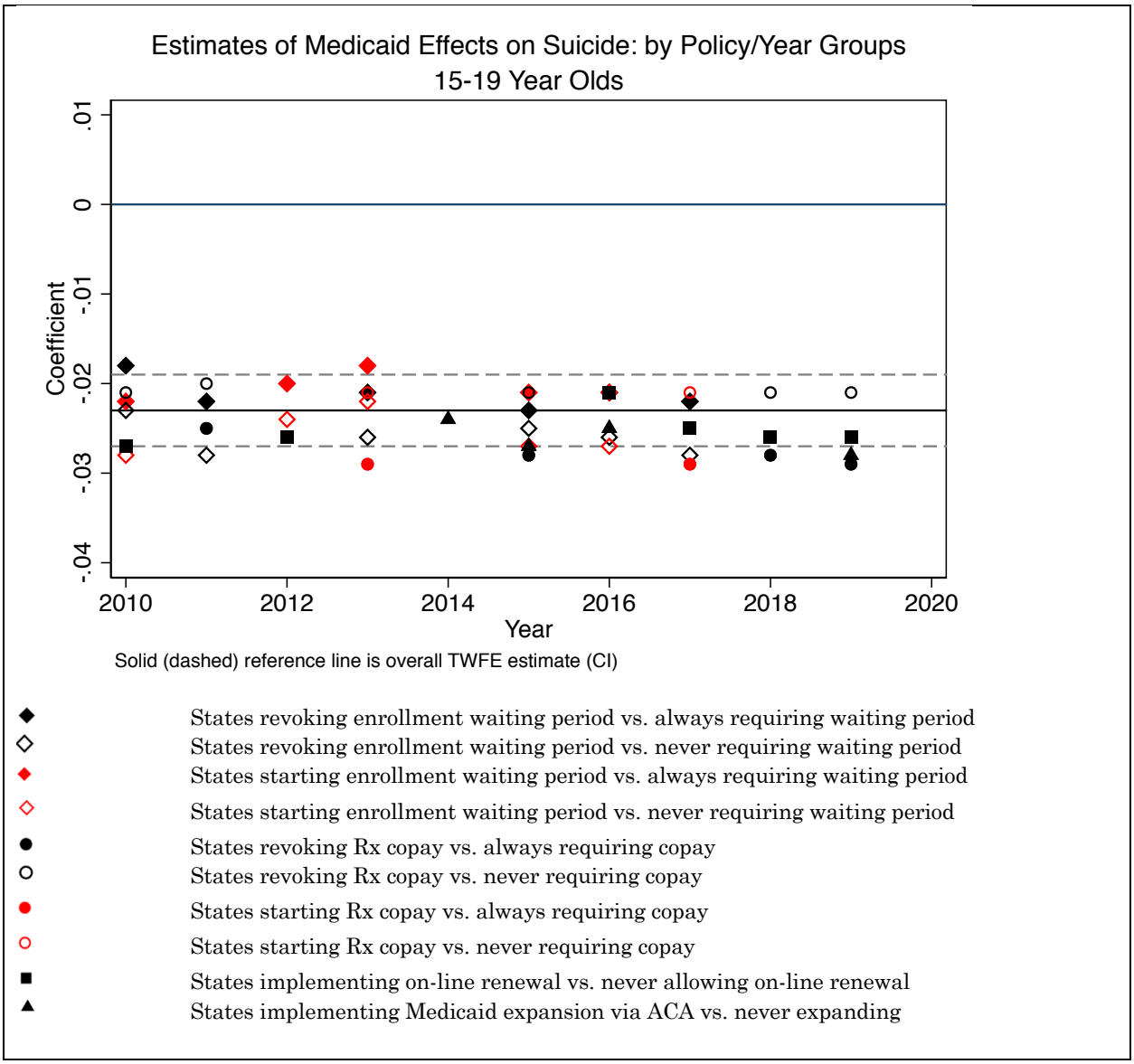

Notes: Authors' calculations using SAMHSA – National Survey of Drug Use and Health from 2010 to 2020. Each horizontal line represents the percent of each age group experiencing a recent major depressive episode by year.

Figure 2




Notes: Authors' calculations using SAMHSA – National Survey of Drug Use and Health from 2010 to 2020. Each horizontal line represents the percent of each age group receiving treatment, among those experiencing a major depressive episode over time.

Figure 3




Notes: Authors' calculations based on the American Community Survey and Multiple Cause of Death Mortality Files from the CDC from 2010 to 2020. Sample includes people aged 15 to 19 years old. Each marker represents a different TWFE estimate of the effect of Medicaid coverage on suicide rates. All regression estimates include age-group, state, and year fixed effects.

Table 1. Summary Statistics

| | Mean | Std. Dev. |
|---|---|---|
| Pct. of Covered by Medicaid | 15.13 | 7.52 |
| Pct. with Any Insurance Coverage | 86.34 | 8.07 |
| Suicides Rate (per 100,000) | 19.82 | 7.53 |
| Prop. HS Dropout | .303 | .033 |
| Prop. HS Grad, no College | .291 | .031 |
| Prop. Some College | .19 | .021 |
| Prop. College Degree | .215 | .051 |
| Prop. Population White | .69 | .161 |
| Prop. Population Black | .109 | .106 |
| Prop. Population Hispanic | .114 | .101 |
| Male Pop./Total Pop. | .494 | .008 |
| Prop. in Poverty | .163 | .033 |
| Pct. Private insurance coverage | 70.5 | 8.0 |
| Pct. Insurance through Employer/Union | 59.4 | 9.3 |
| Pct. Insurance purchased directly | 11.7 | 4.8 |
| Pct. Public insurance coverage | 22.3 | 16.8 |
| Pct. Medicaid | 15.1 | 7.5 |
| Pct. Medicare | 8.3 | 14.6 |
| Pct. VA coverage | 2.1 | 1.8 |

Notes: Authors' calculations based on the American Community Survey and Multiple Cause of Death Mortality Files from the CDC from 2010 to 2020.

Table 2. Medicaid Enrollment and Suicide

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Pct. w/ Any Coverage | .004*** | .004*** | .006*** | .006* |
| | (.002) | (.002) | (.002) | (.003) |
| Prop. HS Grad, no College | -1.043 | -1.042 | -1.077 | 4.033* |
| | (.947) | (.948) | (1.005) | (1.537) |
| Prop. Some College | -1.309 | -1.309 | -2.127* | 5.907*** |
| | (.976) | (.976) | (1.093) | (1.391) |
| Prop. College Degree | -2.712** | -2.713** | -2.304* | 1.027 |
| | (1.13) | (1.13) | (1.254) | (1.506) |
| Prop. Population White | 2.724*** | 2.72*** | .313 | -2.103** |
| | (.8) | (.8) | (1.112) | (0.613) |
| Prop. Population Black | 1.14 | 1.138 | -1.165 | -2.023** |
| | (.945) | (.945) | (1.29) | (0.589) |
| Prop. Population Asian | 4.233*** | 4.234*** | 1.44 | -4.091*** |
| | (1.164) | (1.165) | (1.621) | (0.821) |
| Prop. Population Hispanic | -.22 | -.222 | -3.463** | -1.764** |
| | (1.22) | (1.221) | (1.678) | (0.649) |
| Male Pop./Total Pop. | 3.352* | 3.353* | 3.282* | 17.051** |
| | (1.728) | (1.727) | (1.73) | (5.308) |
| Prop. in Poverty | .544 | .545 | .052 | 1.383 |
| | (.366) | (.366) | (.446) | (1.318) |
| Pct. Covered by Medicaid | -.002 | -.002 | | |
| | (.002) | (.002) | | |
| ***Medicaid by Age Group:*** | | | | |
| 15-19 year olds | | | -.023*** | -0.023*** |
| | | | (.002) | (0.003) |
| 20-24 year olds | | | -.007*** | -0.007* |
| | | | (.002) | (0.003) |
| 25-29 year olds | | | -.003* | -0.003 |
| | | | (.002) | (0.003) |
| 30-34 year olds | | | -.003* | -0.004 |
| | | | (.002) | (0.004) |
| 35-39 year olds | | | -.002 | -0.002 |
| | | | (.002) | (0.004) |
| 40-45 year olds | | | 0.001 | 0.001 |
| | | | (.002) | (0.005) |
| 45-49 year olds | | | .006** | 0.006 |
| | | | (.002) | (0.005) |
| 50-54 year olds | | | .006** | 0.007 |
| | | | (.002) | (0.005) |
| 55-59 year olds | | | .002 | 0.003 |
| | | | (.002) | (0.005) |
| 60-64 year olds | | | -.011*** | -0.010* |
| | | | (.003) | (0.005) |
| Group Fixed Effect? | Yes | Yes | Yes | Yes |
| State Fixed Effect? | Yes | Yes | Yes | No |
| Time Control? | Year FE | Group Trend | Year FE | No |
| Observations | 5634 | 5634 | 5634 | 5634 |
| R-squared | .774 | .771 | .762 | |

*Notes: Authors' calculations based on the American Community Survey and Multiple Cause of Death Mortality Files from the CDC from 2010 to 2020. Table includes TWFE estimates of the impact of Medicaid coverage from multiple model specifications. Standard errors clustered on state in parentheses.*
**** p<.01, ** p<.05, * p<.1*

Table 3 Prediction Models of Medicaid Enrollment Changes, 2009-2020

| Estimator<br>*Regularization* | OLS<br>*n.a.* | LASSO<br>*AIC* | LASSO<br>*BIC* | LASSO<br>*Adaptive* |
|---|---|---|---|---|
| State Implemented ACA? | 3.71*** | 3.567 | 3.696 | 2.399 |
| | (0.146) | | | |
| Waiting Period for Children? | -0.56*** | -0.56 | -0.627 | |
| | (0.131) | | | |
| Copay for Doctor visit? | 0.34** | | | |
| | (0.165) | | | |
| Copay for ER visit? | 0.139 | 0.606 | | |
| | (0.158) | | | |
| Copay for Hospital stay? | 0.96*** | 0.639 | | |
| | (0.217) | | | |
| Copay for RX fill? | -1.15*** | -2.057 | -1.702 | -1.074 |
| | (0.171) | | | |
| Medicaid Renewal On-line? | -0.131 | 0.257 | 0.277 | 0.353 |
| | (0.111) | | | |
| Continuous Eligibility? | -0.093 | -0.278 | | |
| | (0.167) | | | |

Notes: Each column reports coefficients on state policy measures to predict Medicaid enrollment rates for age/year/state cells. Each model controls for state demographic and economic measures and state, year and age group fixed effects (as in Model 1). The first column reports coefficients from a regression of Medicaid enrollment rates on all control variables from Model 1 and the eight policy measures obtained from KFF. Columns 2-4 report coefficients selected via LASSO estimation, with cross-fold validation and different regularization penalties, defined in the column head.
*** *p<.01,* ** *p<.05,* * *p<.1*

Table 4. Policy Changes

| | Policy Adoption or Cessation Year | | | | | | | | | | | Never Adopted Policy | Always Had Policy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Discretionary Medicaid Policy** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | | |
| Expanded Medicaid by Adopting ACA Provisions | | | | | AR AZ CA CO CT DE DC HI IA IL KY MA MD MI MN ND NJ NM NV NY OH OR RI VT WA WV | IN NH PA | AK LA MT | | | ME VA | | | AL FL GA KS MO MS NC NE OK SC SD TN TX WI WY |
| Required a Copay for Prescription Drugs | OH* | CT* LA* NH* NM* | | GA | | NH* VT* | | PA WV | PA* TX* WV* | KY* | | AL AR CO FL IL NC NJ TN UT VA WY | AK AZ DC DE HI IA ID KS MA MD ME MI MN MO MS NE NV NY OK OR RI SC SD VT WA |
| Allowed Medicaid Renewal Online | AL AZ FL IA LA MI NE PA TX VA WI WV | | NJ UT | | | | CA CO CT DE GA HI ID KY MA MD ME MT ND NH NM NY OH OK OR RI SD WA WY | DC VT | IL | | | | AK AR IN KS MN MO MS NC SC TN |
| Waiting Period Between Enrollment and Benefits for Children | AK* MO | SC* | IA KS LA MA NY PA | NH* VT* | | AL* AZ* CA* CO* CT* DE* ID* KY* MA* MD* MN* MO* MT* NM* NV* OR* PA* TN* VA* WA* WV* IL | MI* WI* AZ | GA* NY* | | | | AR FL IN ME NJ SD TX UT WY | DC HI MS NC NE OH OK RI |

Notes: Data comes from the Kaiser Family Foundation. States with an asterisk dropped the policy in the year listed. For example, Ohio dropped their RX copay policy in 2010. States without an asterisk started their respective policy in the year listed. For example, Georgia started their Rx copay policy in 2013.

Table 5. TWFE estimates with Medicaid Expansion Treatment and Control Groups

| | 2014 | 2015 | 2016 | 2019 |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Pct. w/ Any Coverage | 0.006** | 0.006 | 0.008* | 0.007 |
| | (0.002) | (0.003) | (0.003) | (0.003) |
| Prop. HS Grad, no College | -0.213 | -0.537 | -1.117 | -0.832 |
| | (1.065) | (1.234) | (1.361) | (1.370) |
| Prop. Some College | -1.642 | -5.546** | -4.839** | -6.358** |
| | (1.252) | (1.449) | (1.325) | (1.582) |
| Prop. College Degree | -1.503 | -0.701 | -0.189 | -1.379 |
| | (1.539) | (2.004) | (1.793) | (2.294) |
| Prop. Population White | -0.384 | 1.307 | 2.498 | 0.715 |
| | (1.185) | (2.102) | (1.420) | (2.539) |
| Prop. Population Black | -1.689 | -1.613 | 0.565 | -1.761 |
| | (1.469) | (1.810) | (1.592) | (2.475) |
| Prop. Population Asian | 1.272 | 6.886 | 4.537 | 4.226 |
| | (1.695) | (4.239) | (2.765) | (3.869) |
| Prop. Population Hispanic | -5.009** | -4.227 | -2.489 | -4.564 |
| | (1.751) | (2.975) | (2.741) | (3.212) |
| Male Pop./Total Pop. | 4.197 | 1.007 | 0.492 | -1.615 |
| | (2.402) | (3.797) | (2.856) | (3.389) |
| Prop. in Poverty | 0.332 | 0.469 | 1.079 | -0.155 |
| | (0.502) | (0.835) | (0.820) | (0.904) |
| Pct. Covered by Medicaid | 0.006** | 0.006 | 0.008* | 0.007 |
| | (0.002) | (0.003) | (0.003) | (0.003) |
| Medicaid by Age Group: | | | | |
| 15-19 year olds | -0.024*** | -0.027*** | -0.025*** | -0.028*** |
| | (0.002) | (0.003) | (0.003) | (0.003) |
| 20-24 year olds | -0.007* | -0.011* | -0.010 | -0.013** |
| | (0.003) | (0.004) | (0.005) | (0.004) |
| 25-29 year olds | -0.003 | -0.004 | -0.005 | -0.006 |
| | (0.002) | (0.003) | (0.003) | (0.003) |
| 30-34 year olds | -0.003 | -0.003 | -0.006* | -0.008* |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| 35-39 year olds | -0.001 | -0.002 | -0.008 | -0.005 |
| | (0.003) | (0.003) | (0.004) | (0.003) |
| 40-45 year olds | 0.000 | 0.003 | -0.003 | -0.001 |
| | (0.003) | (0.004) | (0.004) | (0.004) |
| 45-49 year olds | 0.006* | 0.011 | 0.002 | 0.004 |
| | (0.003) | (0.005) | (0.005) | (0.005) |
| 50-54 year olds | 0.006* | 0.008 | -0.001 | 0.004 |
| | (0.003) | (0.006) | (0.005) | (0.005) |
| 55-59 year olds | 0.003 | 0.002 | -0.006 | -0.003 |
| | (0.003) | (0.005) | (0.004) | (0.005) |
| 60-64 year olds | -0.009* | -0.014* | -0.018** | -0.017** |
| | (0.004) | (0.005) | (0.005) | (0.005) |
| Observations | 4236 | 1844 | 1836 | 1725 |
| R-squared | | | | |

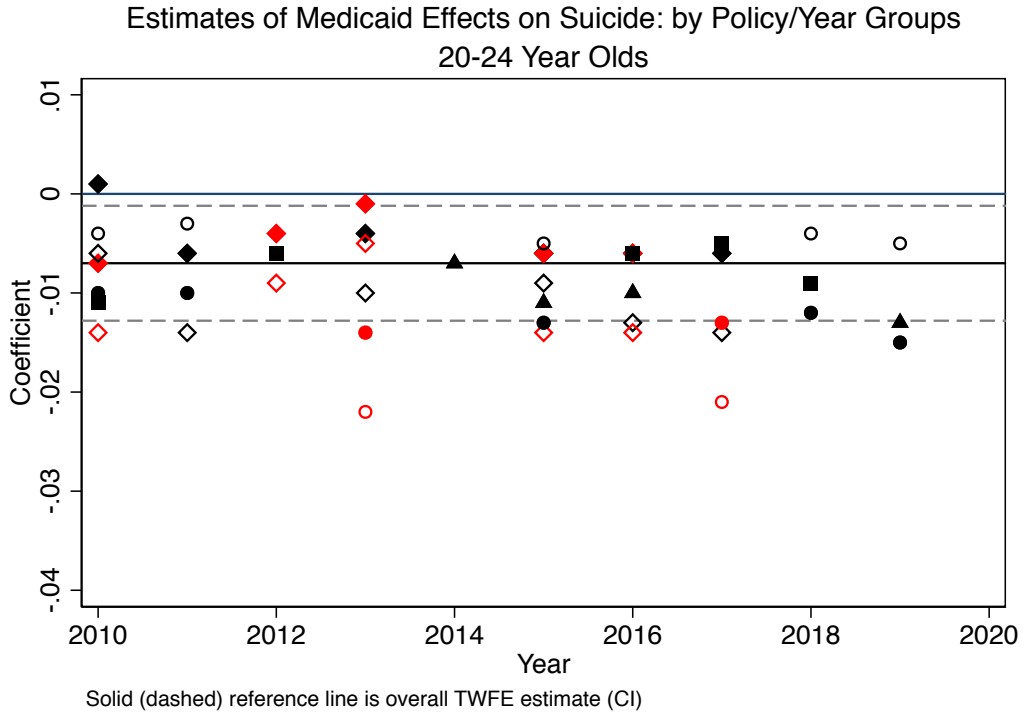
Notes: Authors' calculations based on the American Community Survey and Multiple Cause of Death Mortality Files from the CDC from 2010 to 2020. Table includes TWFE estimates of the impact of Medicaid coverage from multiple model specifications. Each column represents a treatment group that includes states that expanded Medicaid in the respective year. Standard errors clustered on state in parentheses. All models control for year and group fixed effects. *** *p<0.01,* ** *p<0.05,* * *p<0.1*

Appendix

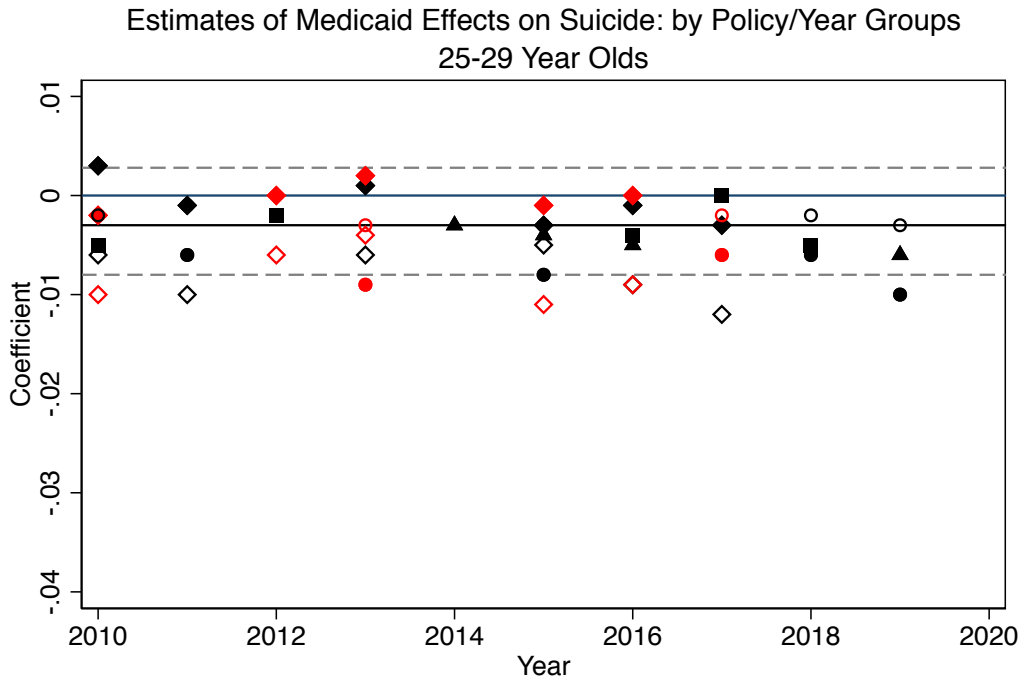
Legend for all Tables:

- ◆ States revoking enrollment waiting period vs. always requiring waiting period
- ◇ States revoking enrollment waiting period vs. never requiring waiting period
- ◆ States starting enrollment waiting period vs. always requiring waiting period
- ◇ States starting enrollment waiting period vs. never requiring waiting period
- ● States revoking Rx copay vs. always requiring copay
- ○ States revoking Rx copay vs. never requiring copay
- ● States starting Rx copay vs. always requiring copay
- ○ States starting Rx copay vs. never requiring copay
- ■ States implementing on-line renewal vs. never allowing on-line renewal
- ▲ States implementing Medicaid expansion via ACA vs. never expanding

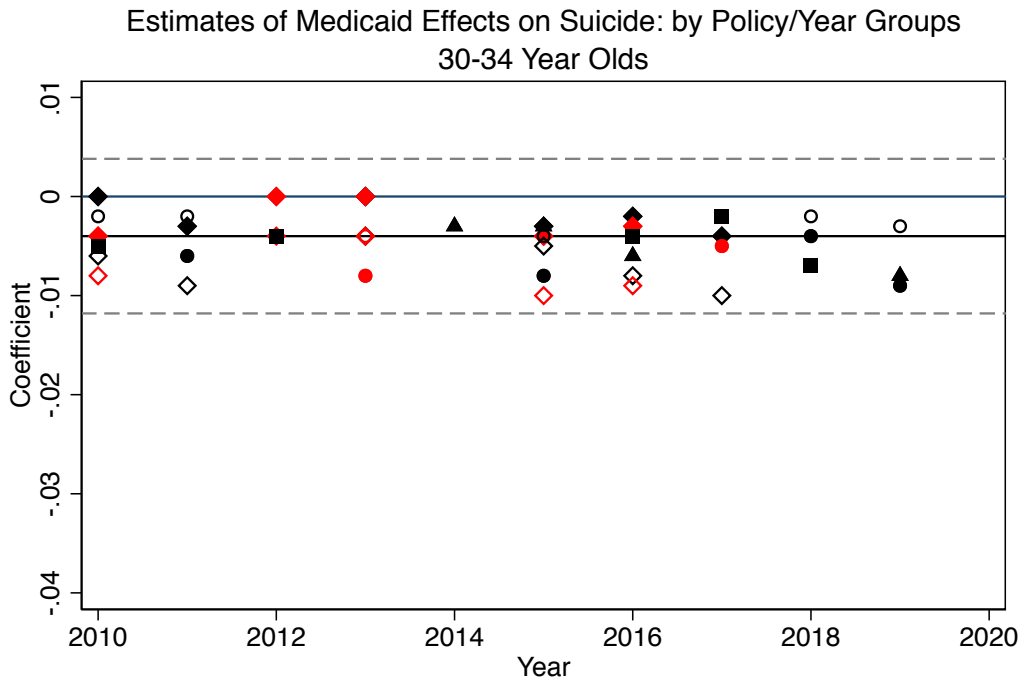
Appendix Figure A1



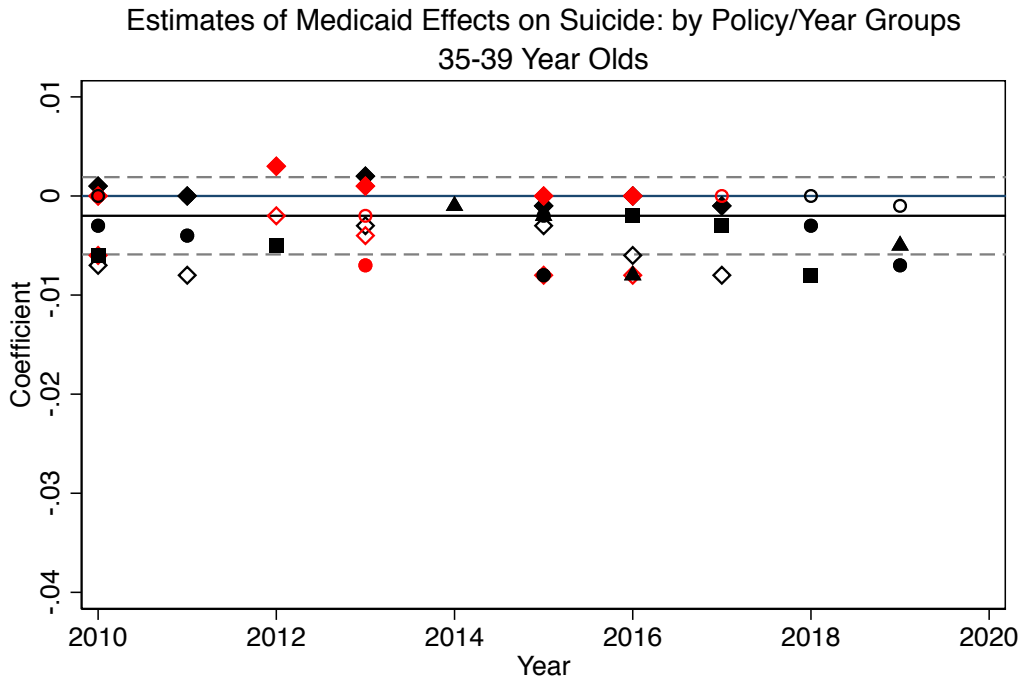
Appendix Figure A2



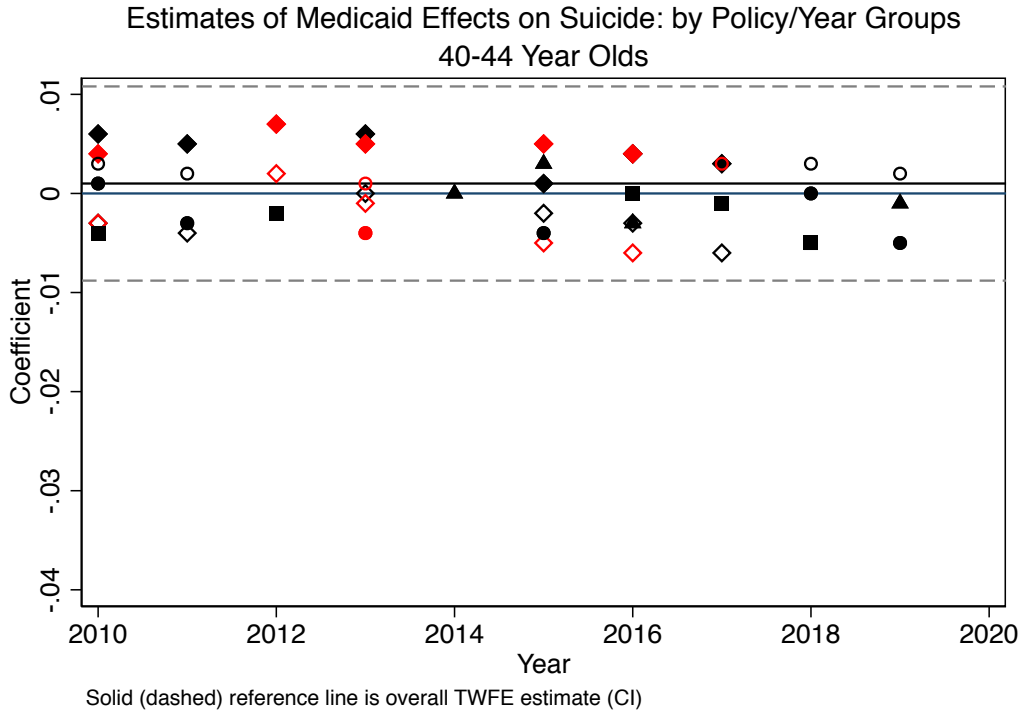

Appendix Figure A3



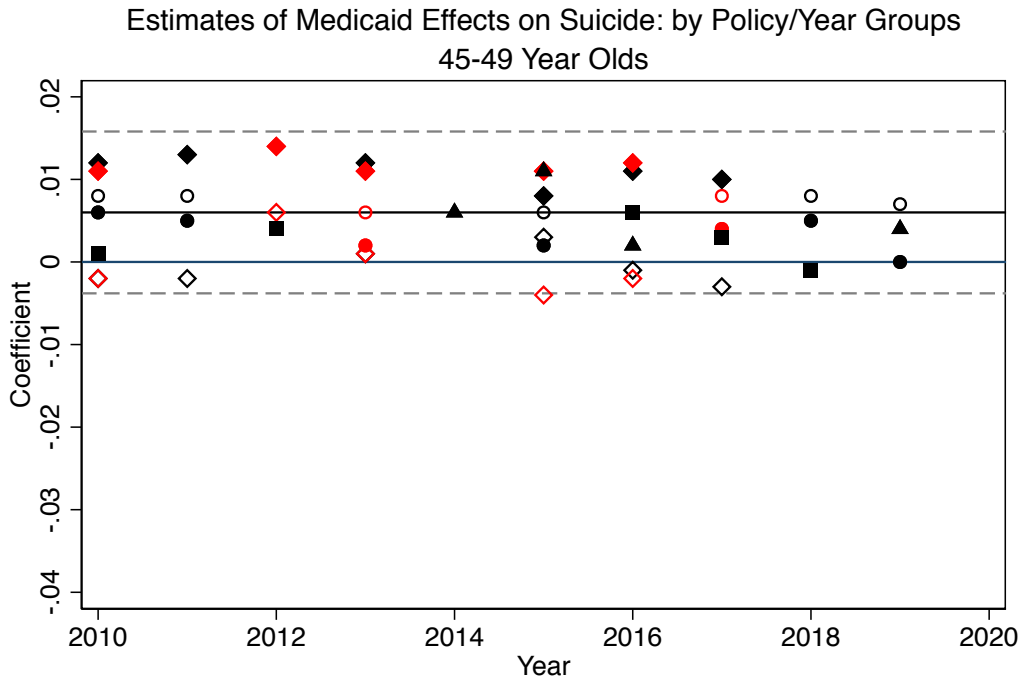
Appendix Figure A4




Appendix Figure A5

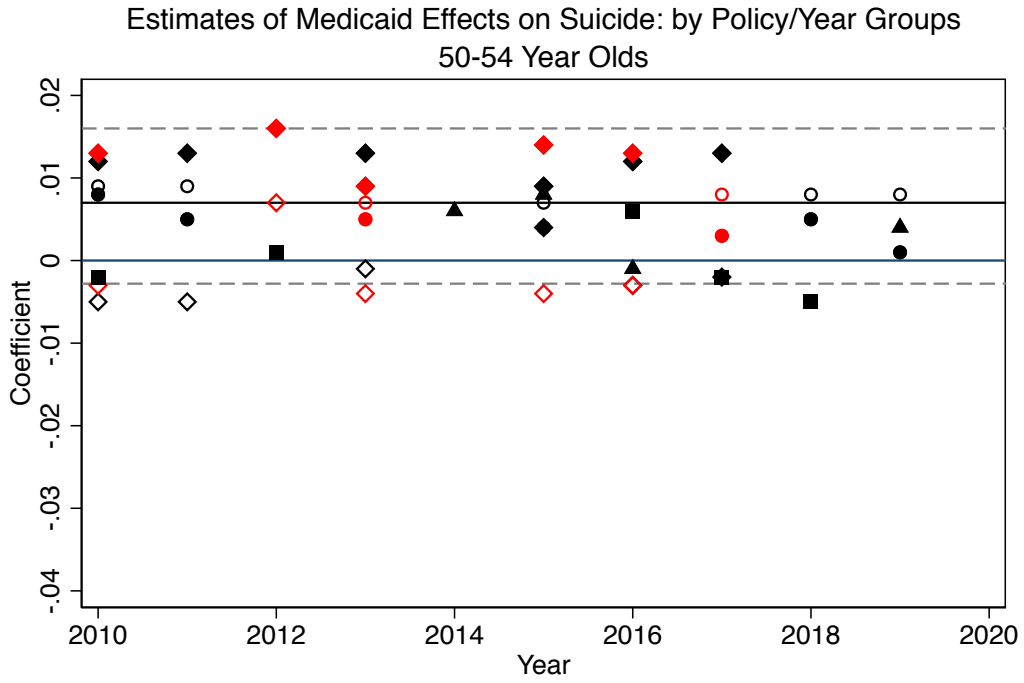


Appendix Figure A6



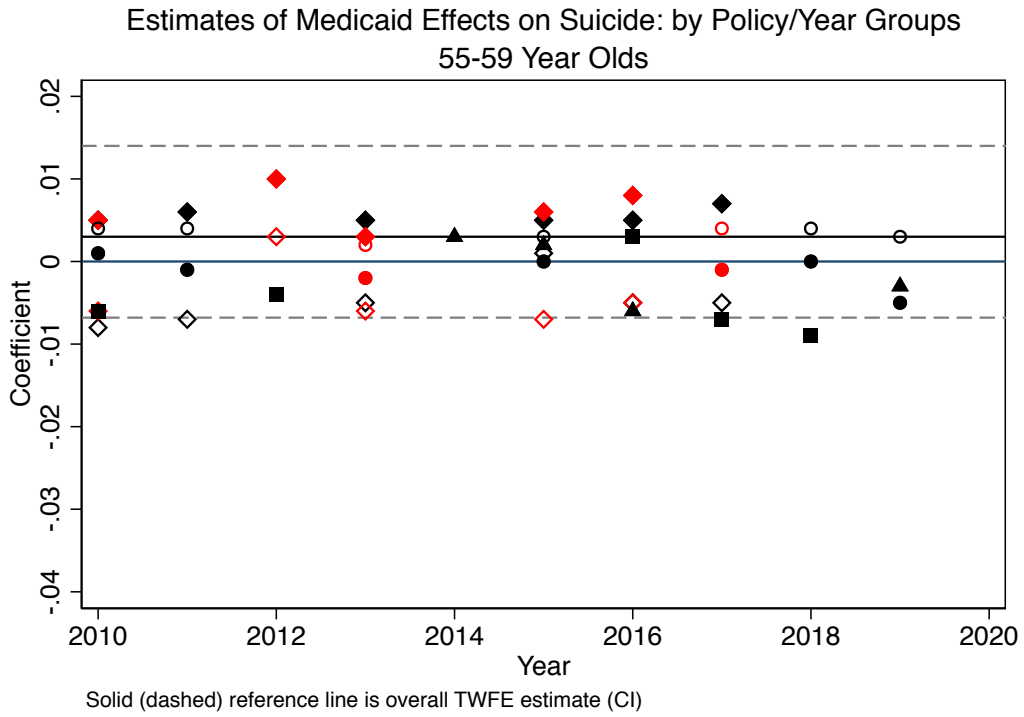

Solid (dashed) reference line is overall TWFE estimate (CI)

Appendix Figure A7




Solid (dashed) reference line is overall TWFE estimate (CI)

Appendix Figure A8




Appendix Figure A9