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ABSTRACT

Mental illnesses are prevalent in the United States, and cost is a critical barrier to treatment receipt. We study the effects of recent and major eligibility expansions within Medicaid on psychotropic prescription medications for mental illness. We estimate differences-in-differences models using administrative data on medications for which Medicaid was a third-party payer 2011-2016. Our findings suggest that these expansions increased psychotropic prescriptions by 22% with heterogeneity across psychotropic class and state characteristics that proxy for patient need, expansion scope, and system capacity. We show that Medicaid, and not patients, financed these prescriptions. Finally, we document that mental illness declined.

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1. Introduction

Mental illnesses are prevalent in the United States and all developed countries (World Health Organization 2017). For example, in 2015 17.9% of U.S. adults met the diagnostic criteria for any mental illness and 4% met criteria for a serious mental illness (Center for Behavioral Health Statistics and Quality 2016). Mental illnesses impose heavy burdens on afflicted individuals as these illnesses harm overall health, employment, and relationships (World Health Organization 2017). In addition to imposing costs internalized by afflicted individuals, mental illnesses levy costs on broader society (Frank and McGuire 2000). Each year mental illnesses cost the U.S. economy $504B in healthcare expenditures, disability payments, and a less productive work force (Insel 2015).[1] Mental illness prevalence is not homogenous across the population; less advantaged groups are more likely to suffer from such illnesses (World Health Organization 2017). Within the U.S., mental illness prevalence is particularly high among low income individuals (Center for Behavioral Health Statistics and Quality 2016).

Although they impose substantial costs, mental illnesses can be effectively treated by primary care providers, who can prescribe psychotropic medications (medications used to treat mental illnesses such as anxiety, depression, and psychosis) and provide brief counseling, and specialty providers (e.g., psychiatrists and psychologists), who can provide intensive psychopharmacological and psychosocial treatment in outpatient or inpatient settings (Olfson 2016). Despite established treatment efficacy (American Psychiatric Association 2006), there is a substantial amount of unmet need for mental illness treatment in the U.S. According to National Survey on Drug Use and Health (NSDUH) data, in 2015, more than half of U.S. adults who could benefit from mental illness treatment did not receive any treatment (Center for Behavioral Health Statistics and Quality 2016). Unmet need for mental illness treatment is particularly high among the uninsured (Garfield et al. 2011). Among individuals who sought care but did not receive it, the most commonly reported reason for failure to receive care was inability to pay for treatment (Center for Behavioral Health Statistics and Quality 2016). Thus, expanding affordable insurance coverage to low-income, uninsured individuals may remove cost-related barriers to unmet mental illness treatment needs and, in turn, reduce mental illness.

[1] The authors inflated this number from the original estimate ($467B in 2012 dollars) to 2017 dollars using the Consumer Price Index.

In 2010, the U.S. federal government implemented the Affordable Care Act (ACA). This Act, arguably the most substantial U.S. healthcare legislation in a generation, was designed to address perceived inadequacies within the healthcare delivery system. A primary objective of the Act was to reduce the level of uninsurance. The ACA increased insurance coverage through three principle policy levers: (i) premium subsidies to purchase private insurance, (ii) mandates that required employers to offer insurance and individuals to hold insurance, and (iii) expanded eligibility for Medicaid; an insurance system that finances healthcare services for the poor (Frean, Gruber, and Sommers 2017). In 2009, the year before the ACA was enacted, the U.S. uninsurance rate was 15.4% (Cohen, Martinez, and Ward 2010). By 2016, uninsurance had fallen to a historically low rate of 9% (Cohen, Zammitti, and Martinez 2017); representing a 42% decline. Another objective of the ACA was to mitigate 'underinsurance': insurance that provides inadequate coverage of healthcare services. In particular, the ACA required that most insurance plans cover ten benefit classes, including both mental illness treatment and prescription medications (Garfield, Lave, and Donohue 2010).

We explore the effects of ACA-related Medicaid expansions that occurred between 2011 and 2016 on psychotropic medications prescribed in outpatient settings for which Medicaid was a third-party payer. While we do not directly capture medication use, prescriptions arguably provide a reasonable proxy for such use (Lehmann et al. 2014). Analyses of pre-ACA data suggest that individuals who gained eligibility through these expansions had elevated need for mental illness treatment (Garfield et al. 2011; Cook et al. 2016), which implies that newly insured populations may benefit from these expansions.

Psychotropic medication treatment is endorsed by providers – in professional practice treatment guidelines these medications are recommended as a component of treatment for most major mental illnesses (American Psychiatric Association 2017) – and common – in 2015, 36.7% of U.S. adults with mental illness used psychotropic medications (Center for Behavioral Health Statistics and Quality 2016). Moreover, access to insurance that covers these medications likely leads to a substantial reduction in out-of-pocket price faced by uninsured individuals seeking treatment; reimbursement rates for mental healthcare providers (e.g., psychiatrists) range from $67 to $114 per visit (Mark et al. 2017) [2] and thus this modality of care is likely

[2] This estimate is derived from commercial insurance claims and may therefore depart to some extent to costs faced by an uninsured patient with mental illness.

unaffordable for many low-income and uninsured individuals. Because patients must receive a prescription from a provider to obtain them, studying psychotropic medications allows us to indirectly explore the ability of newly insured individuals suffering from mental illness to form relationships with providers and navigate the healthcare system.

Standard economic theory suggests that Medicaid expansions, by reducing out-of-pocket prices, will increase the quantity of prescriptions demanded by the newly enrolled suffering from mental illnesses (Grossman 1972). Moreover, increased awareness of mental illness treatment and its benefits may occur with Medicaid expansion, which may increase demand for psychotropic medications. There are numerous factors that may mute expansion effects, however: mental illness and treatment stigma, new patients' unfamiliarity with the healthcare delivery system, limited participation in Medicaid by healthcare providers, well established mental healthcare provider shortages, and so forth (Decker 2012; Center for Behavioral Health Statistics and Quality 2016; Bishop et al. 2014; Thomas et al. 2009). Thus, the extent to which Medicaid expansions lead to increases in psychotropic medication prescriptions is ultimately an empirical question. We attempt to provide empirical evidence on this relationship.

We couple administrative data on the universe of prescriptions obtained in outpatient settings and purchased through retail and online pharmacies for which Medicaid was a third-party payer with differences-in-differences models to estimate Medicaid effects. These models leverage within-state variation in Medicaid eligibility between 2011 and 2016. Our findings suggest that, post-expansion, psychotropic prescriptions increased 22% in expanding states relative to non-expanding states. Additionally, we show that here was substantial heterogeneity in Medicaid effects by psychotropic class and state characteristics in effect sizes. Increased prescriptions were financed by Medicaid and not patients. In an extension we provide evidence that mental illness declined in expanding states.

The paper proceeds as follows. Section 2 offers a discussion of Medicaid, with emphasis on the ACA expansions we study, and the related literature. Data, variables, and methods are outlined in Section 3. Results are reported in Section 4. Extensions to the main analysis and robustness checking are reported in Section 5. A discussion is provided in Section 6.

2. Medicaid and related literature

2.1 Medicaid and ACA-related expansions

Established in 1965, Medicaid is the primary insurer for low-income families, low-income elderly Medicare[3] beneficiaries, and disabled individuals in the U.S., covering 77 million individuals in 2017 (Sommers and Grabowski 2017). Medicaid is a joint federal-state program, with the federal government setting minimum eligibility and coverage standards. States historically had ample latitude to determine specific eligibility criteria and benefit design within the federal standards. Prior to the ACA, most states limited Medicaid eligibility to the disabled and low-income parents; other low-income groups (e.g., childless, non-disabled adults) were not eligible for coverage. Medicaid is characterized by low patient cost-sharing and coverage of a relatively expansive list of healthcare services, including mental illness services (Kaiser Family Foundation 2017). Of particular relevance to our study, comparison of plans suggests that Medicaid may provide more generous coverage for mental illness services than many private insurance plans (Garfield, Lave, and Donohue 2010; Rosenbaum et al. 2015).

Beginning in 2014, as part of the ACA, Medicaid was expanded in 31 states and the District of Columbia (as of November 2017) to cover parents and other non-disabled adults with incomes up to 138% of the Federal Poverty Level [FPL] (Kaiser Commission on Medicaid and the Uninsured 2016). Categorical restrictions were removed. Individuals who gained eligibility through these Medicaid expansions are referred to as 'newly eligible' and are insured by 'expansion' plans that generously cover both mental illness treatment and prescription medications (Garfield, Lave, and Donohue 2010). Originally, the ACA legislated that the Medicaid expansion was to occur nationally. Non-compliant states were to be denied all federal Medicaid funds. However, in 2012, the U.S. Supreme Court ruled that states would not lose federal funds if they choose not to expand Medicaid. Thus, the decision to expand, or not expand, Medicaid was left to states' discretion. We leverage these state decisions in our empirical models (differences-in-differences; outlined later in the manuscript).

Although we emphasize the newly eligible population in our study, other groups experienced changes in insurance status and eligibility post-ACA. (i) Through 'welcome mat' effects, individuals who were previously eligible enrolled in Medicaid (Frean, Gruber, and Sommers 2017). (ii) In all states – both expansion and non-expansion – income eligibility was

[3] Medicare, also established in 1965, is a public insurance system for the elderly and patients suffering from specific diseases (e.g., end stage renal disease) in the U.S.

increased by five percentage points (this increase occurred with the migration to the 'Modified Adjusted Gross Income' [MAGI] criteria for determining program eligibility[4]). For expansion states the post-ACA income threshold is 138% of FPL (133% plus 5 percentage points) and for non-expansion states the post-ACA income threshold is 5 percentage points above the state's Medicaid income threshold in March 2010 (i.e., in advance of implementation of the major provisions of the ACA). These groups are not referred to as newly eligible and are not covered by expansion plans (Garfield, Lave, and Donohue 2010). We leverage variation in Medicaid eligibility for the newly eligible group, but we note the possibility that welcome mat effects and the effect of increasing income eligibility by five percentage points may differ across expansion and non-expansion states. If such differences are present, our estimates will conflate these three distinct effects. Nonetheless, studying the overall effects of the ACA-related Medicaid expansion is an important first order question for understanding whether a large-scale public insurance expansion leads to changes in psychotropic medication prescriptions among low-income populations with little historic access to insurance and elevated need for such treatment. We encourage further research, relying on other data sources that allow the researcher to isolate particular groups, to explore the potentially differential effects across groups that gained Medicaid insurance through these expansions.

A robust and growing literature shows that the ACA Medicaid expansions lead to large decreases in the uninsured rate among groups eligible for expansion coverage (Wherry and Miller 2016; Frean, Gruber, and Sommers 2017; Sommers et al. 2015; Miller and Wherry 2017). Moreover, Medicaid expansions increased access to care as measured by having a personal doctor, receiving an annual check-up, and ability to pay for needed treatment (Sommers et al. 2016; Sommers et al. 2017; Miller and Wherry 2017); improved financial security (Hu et al. 2016); and improved self-assessed health (Simon, Soni, and Cawley 2017).[5]

2.2 Medicaid and mental illness

While there are numerous studies into the effects of Medicaid expansions on general health and healthcare use, there is substantially less evidence on the effects of such expansions on mental illness. In particular, little is known on the effects of Medicaid expansions on

[4] More details are available at https://www.healthcare.gov/glossary/modified-adjusted-gross-income-magi/ [accessed August 17th, 2017].

[5] We note that not all studies demonstrate self-assessed health gains. See, for example, Courtemanche et al. (2017) and Miller and Wherry (2017).

psychotropic medications. This dearth represents a serious gap in our understanding of Medicaid health effects as use of psychotropic medications is an important indicator of access to prescribing physicians, is recommended as part of efficacious treatment for most major mental illnesses (American Psychiatric Association 2017), and reflects a large share of mental illness treatment received in the U.S. (Center for Behavioral Health Statistics and Quality 2016). Moreover, a concern among policymakers is that mental healthcare demand is more elastic than general healthcare (Frank and McGuire 2000) and insurance expansions may lead to particularly high costs for payers. Hence, providing evidence on the mental healthcare insurance-elasticity is critical for understanding how expansions will change service use, health, and costs.

Two studies examine the effects of Medicaid on overall mental illness service use and unmet treatment need using variation afforded by pre-ACA state expansions and offer conflicting findings. Golberstein and Gonzales (2015) find little effect of Medicaid on mental illness service use using the Medical Expenditure Panel Survey. On the other hand, Wen, Druss, and Cummings (2015) utilize NSDUH data to show Medicaid expansions increased the probability of receiving mental illness treatment and reduced reports of unmet treatment need.[6]

While these studies are important, they have primarily focused – due to the exogenous sources of variation they leverage for identification – on traditional Medicaid populations and/or the pre-ACA period. In comparison, we examine expansions to non-traditional populations – low-income and non-disabled adults – in a very recent time period across U.S. states. Moreover, while the above-noted studies examine mental illness treatment overall, we examine psychotropic medications. Psychotropic medications filled by physicians in outpatient and primary care settings can allow individuals to fulfill standard work and family commitments and are likely less stigmatized, therefore are perhaps more appealing to patients than other forms of treatment (e.g., care received in specialty treatment facilities such as a hospital or a residential rehabilitation center). Relatedly, there have been recent, important advancements in terms of

[6] While it is beyond the scope of our study to reconcile findings across these studies, we suspect that differences in the manner in which the authors model Medicaid expansion may play a role. Golberstein and Gonzales impute Medicaid eligibility following Cutler and Gruber (1996). Wen et al use indicator variables for a Section 1115 waivers expansion and specific features of the waivers (such waivers allow states to adjust Medicaid by expanding coverage to groups not historically eligible, for example: https://www.medicaid.gov/medicaid/section-1115-demo/index.html [accessed August 15th, 2017]). See Hamersma and Kim (2013) for a discussion of various approaches to modelling pre-ACA Medicaid expansions. In addition, the studies leverage different datasets, with the MEPS being nationally representative and the NSDUH being representative at the state level. Finally, there are modest differences in control variables, sample definitions, and time periods across the two studies.

available psychotropic medications (e.g., in treatment of depression, combining or 'augmenting' standard antidepressants with psychotropic medications used to treat other mental illnesses is a recent innovation in prescribing patterns[7] and there are numerous new psychotropic medications approved by the Food and Drug Administration [FDA] over our study period[8]) since passage of the ACA. Given that the technology of mental healthcare treatment has changed we may expect that responses to insurance expansions and other major policy changes may have also changed.

To the best of our knowledge, only one study examines the effect of ACA-related Medicaid expansions on mental illness treatment. In an extension to their main analyses of the effect of ACA-related Medicaid expansions on overall prescriptions Ghosh, Simon, and Sommers (2017), using claims data, find that psychotropic medications increased 19%, post-expansion, in expanding states relative to non-expanding states (overall prescriptions increased by the same percent).

Our analysis builds on the Ghosh, Simon, and Sommers (2017) analysis in several important ways. (i) We assess heterogeneity across classes of psychotropic medications: antidepressants, anti-anxiety medications, anti-psychotics, mood stabilizers, and stimulants. Understanding the impact of Medicaid expansion on sub-classes of psychotropic medications provides critical evidence for policymakers assessing changes in the use of psychotropic medications shown to be beneficial for patients and those that present a higher risk to patients, and how insurance expansions may impact links to providers qualified to prescribe these medications. (ii) We directly estimate the overall costs of increases in psychotropic medication; costs are an essential input for assessing the value of major policy initiatives such as the Medicaid expansions we study. (iii) We test the extent to which state Medicaid programs vs. patients assumed the financial responsibility of increased psychotropic medication prescriptions, which allows us to shed additional light on the distributional effects of Medicaid expansion. (iv) We examine how Medicaid effects vary across state characteristics (e.g., uninsurance, mental illness prevalence, number of primary care physicians) that proxy for expansion scope, patient need, and system capacity. (v) We are able to study longer-term expansion effects as we have access to 36 months post-expansion (vs. 15 post-expansion months examined by Ghosh and

[7] https://psychcentral.com/lib/depression-new-medications-on-the-horizon/; accessed November 12th, 2017.
[8] See for example https://www.i-lawsuit.com/timeline-of-psychopharmacological-medications/ and https://www.centerwatch.com/drug-information/fda-approved-drugs/therapeutic-area/17/psychiatry-psychology; accessed November 12th, 2017.

colleagues). The longer duration of post-expansion time that we use in our study allows us to better assess whether the newly enrolled have access to continued treatment for mental illness, a chronic condition. (vi) We explore the effects of Medicaid expansion on mental illness.

3. Data and methods

3.1 Prescription medications

We draw data on Medicaid-financed prescription medications from the State Drug Utilization Database (SDUD). The Centers for Medicaid and Medicare (CMS) compile the SDUD using state data supplied by Medicaid programs. The SDUD includes the universe of outpatient prescription medications purchased at retail and online pharmacies and covered under the Medicaid Drug Rebate Program for which Medicaid serves as a third-party payer (U.S. Department of Health and Human Services 2012).

While the SDUD has included information from fee-for-service (FFS) since its inception, data on prescriptions financed by managed care (MC) plans were added to the SDUD in March 2010 following implementation of the Drug Rebate Equalization Act (2009). We use data from 2011 onward to examine both FFS and MC given the movement away from FFS and toward MC within Medicaid over time (Hurley and Somers 2003). For example, in 2014, the year in which most ACA Medicaid expansions occurred, 77% of all Medicaid enrollees were covered by a MC plan (Kaiser Family Foundation 2014).[9]

We use SDUD data in all quarters between 2011 and 2016, yielding 24 periods of data for each state and the District of Columbia: 12 periods pre-2014 and 12 periods post-2014. We exclude Arizona, Hawaii, Kansas, Ohio, Rhode Island, and Virginia due to odd missing data patterns following Maclean, Pesko, and Hill (2017).[10]

We study overall prescriptions for medications with indications for mental illnesses, and consider heterogeneity across major psychotropic groups: anti-depressants, anti-anxiety medications, anti-psychotics, mood stabilizers, and stimulants. Medications classes and included medications are listed in Table 1. To form the set of medications to examine, we first use medications provided by the National Institute of Mental Health to identify the medications in

[9] In 2013, the year before most ACA Medicaid expansions, just 72% of enrollees were covered by a MC plan.
[10] These states' data showed large and unexplained spikes in prescriptions in at least one quarter of our study period. Maclean et al used SDUD through 2015 and did not drop Kansas. We chose to drop Kansas as this state displayed odd data patters in 2016. More details are available on request.

each psychotropic class. Next we refer to each medications' Medline webpage to broaden the list of included medications. Only medications with FDA indicators for treatment of adult mental illness are included in our analyses.[11] We identify medications in the SDUD with crosswalks between National Drug Codes (Roth 2017).

3.2 Medicaid expansions

Our classification of expansion states and expansion dates follows Maclean, Pesko, and Hill (2017) and is listed in Table 2. The majority of states expanded Medicaid on January 1st, 2014 in conjunction with core ACA provisions. Two states expanded later in 2014 (Michigan, New Hampshire). Five states expanded in 2015 or 2016 (Alaska, Indiana, Louisiana, Montana, Pennsylvania). Prior to 2011, 4 states (Delaware, Massachusetts, New York, Vermont) and the District of Columbia expanded Medicaid eligibility to cover parents and childless adults with full benefits through 100% FPL or higher, and continued to enroll new beneficiaries into the program. We code these states as treated throughout our study period.

We match Medicaid expansion dates to the SDUD by state, year, and quarter. Our expansion state classification algorithm closely follows prior examples; e.g., Wherry and Miller (2016), and Simon, Soni, and Cawley (2017). We report later in the manuscript that are results are robust to using these alternative coding schemes.

3.3 Outcomes

We construct variables that reflect Medicaid-financed prescriptions for psychotropic medications. These include the number of prescriptions filled overall and within five psychotropic classes (anti-depressants, anti-anxiety, anti-psychotics, mood stabilizers, and stimulants). We convert all outcome variables to the rate per 100,000 18-64 year olds in the state using data from the American Community Survey (ACS) (Ruggles et al. 2015) and Census population data available through the University of Kentucky Center for Poverty Research Center (2016). Specifically, we multiply the state population from the U.S. Census data by the share of the population that is 18 to 64 years of age (calculated in the ACS) in each year of our study. We chose to focus on the 18 to 64 year old population as this group was the primary target of the ACA-related Medicaid expansions we study (Frean, Gruber, and Sommers 2017).

[11] https://www.nimh.nih.gov/health/topics/mental-health-medications/index.shtml (accessed May 5th, 2017). We note that these lists do not provide a complete enumeration of all psychotropic medications used to treat mental illness. However, we argue that they reflect a substantial share of medications plausibly available to a Medicaid patient. Our medication selection was further informed by one of the authors who is a practicing psychiatrist.

3.4 Controls

We attempt to control for variables that plausibly predict our outcomes and a state's propensity to expand Medicaid with the ACA implementation in our regression models, and minimize omitted variable bias. To this end, we merge state-level variables into the SDUD.[12]

(i) We link the annual seasonally adjusted unemployment rate from the Bureau of Labor Statistics and the poverty rate (University of Kentucky Center for Poverty Research Center 2016) to the SDUD. (ii) We merge in demographics from the ACS (age, sex, race, ethnicity, education). (iii) We link factors that possibly reflect sentiment toward social policies targeting the poor (University of Kentucky Center for Poverty Research Center 2016): a Democrat governor, monthly maximum Temporary Assistance for Needy Family (TANF) for a family of four, the effective minimum wage, and the state-to-federal Earned Income Tax Credit (EITC) ratio. We translate monetary variables to 2016 dollars using a healthcare cost Gross Domestic Product (GDP) deflator (Dunn, Grosse, and Zuvekas 2016).

3.5 Model

Our differences-in-differences (DD) model is specified in Equation (1):

$$(1) \qquad M_{st} = \alpha_0 + \alpha_1 Ex_{st} + \alpha_2' X_{st} + S_s + \tau_t + \Omega_{st} + \varepsilon_{st}$$

This model is standard within the literature that explores the health and healthcare effects of the ACA Medicaid expansions (Ghosh, Simon, and Sommers 2017; Miller and Wherry 2017; Saloner et al. 2017; Maclean, Pesko, and Hill 2017; Simon, Soni, and Cawley 2017).

M_{st} is a psychotropic prescription variable in state *s* in state/year/quarter ('period') *t*. Ex_{st} is an indicator for whether or not a state has expanded its Medicaid program in period *t*. X_{st} is a vector of time-varying state characteristics. S_s and τ_t are vectors of period fixed effects. Inclusion of state fixed effects allows for control of time-invariant state factors that are unobservable to the econometrician. Period fixed effects control for national trends in prescriptions. We also include state-specific linear time trends (Ω_{st}). More specifically, we interact each state fixed effect with a linear time trend that takes on a value of 1 in 2011 Q1, 2 in 2011 Q2, and so forth. Including these trends allows each state to follow a separate linear trend in outcomes and allows us to control for time-varying state-level unobservable (to the

[12] We note that many of the control variables we link to the SDUD are not yet available for 2016, the final year of our study period. We linearly extrapolate the 2016 values for these variables. We will incorporate the 2016 values into our analyses as they become available. However, we have re-estimated our models using the 2011-2015 period and results are robust. See Supplementary Table 1. Details are available from the corresponding author on request.

econometrician) factors. ε_{st} is the error term. We report later in the manuscript that our findings are not sensitive to this particular specification, however.

We cluster standard errors around the state (Bertrand, Duflo, and Mullainathan 2004). The 45 clusters in our analysis dataset allow us to consistently estimate standard errors (Cameron and Miller 2015). We estimate all regressions using unweighted OLS, although as we show later in the manuscript results are robust to applying population weights.

3.6 Internal validity testing

A necessary assumption for the DD model to recover causal estimates is that the treatment and comparison groups would have followed the same trend in the post-treatment period, had the treatment states not been treated. This assumption is untestable as expansion states did expand Medicaid and thus we cannot observe these states in the untreated state post-expansion. We attempt to provide suggestive evidence on this assumption in two ways.

(i) We examine unadjusted trends in the pre-expansion period in our outcome variables for the treatment group and 2011-2013 for the comparison group. If we find that the outcomes appear to have trended similarly in the pre-treatment period across these groups, such trends provide suggestive evidence that the SDUD data satisfy the parallel trends assumption. (ii) Using pre-Medicaid expansion data for each expanding state and 2011-2013 data for non-expanding states,[13] we estimate the regression model outlined in Equation (2):

(2) $$M_{st} = \gamma_0 + \gamma_1 Treat_s * Trend_t + \beta_2' X_{st} + S_s + \tau_t + \epsilon_{st}$$

We replace the Ex_{st} variable in Equation (1) with an interaction between the treatment group indicator ($Treat_s$) and a linear time trend ($Trend_t$).[14] If we cannot reject the null hypothesis that γ_1 is zero, this finding provides support that our data satisfy the parallel trends assumption. States with substantial expansions prior to 2011 are excluded from validity tests (see Table 2).

4. Results

4.1 Summary statistics

Table 3 reports summary statistics for expansion and non-expansion states in the period 2011-2013. We use 2011-2013 data for states that expanded Medicaid after January 1st, 2014 in validity testing (see Table 2). In expanding states, the quarterly number of psychotropic

[13] We use 2011-2013 data for states that expanded Medicaid after January 1st, 2014 in validity testing (see Table 2).
[14] We do not include state-specific linear time trends in Equation (2) because these would be perfectly collinear with our main interaction testing for pre-expansion parallel trends between expanding and non-expanding states.

prescriptions per 100,000 non-elderly adults was 9,641. The number of quarterly prescriptions for anti-depressants, anti-anxiety medications, anti-psychotics, mood stabilizers, and stimulants was 2,940; 2,598; 2,034; 1,239; and 830. Within non-expanding states the comparable quarterly prescriptions per 100,000 non-elderly adults was 9,169; 2,702; 2,327; 1,839; 1,496; and 806. Thus, medication use was higher in expanding states than non-expanding states, pre-expansion.

Turning to control variables, there were clear level differences between expanding and non-expanding states in the pre-expansion period; e.g., higher unemployment rates in expanding states. We control for all these variables in our regression model and DD models require common trends, not levels, for identification.

4.2 Internal validity testing

Figures 1 through 6 report graphical analysis of trends in outcomes aggregated to the year-treatment level; we aggregate to this level to smooth out noise in the SDUD data and we exclude states that expand prior to January 1st, 2014. We first consider unadjusted trends in the pre-period to investigate the ability of the SDUD to satisfy parallel trends. Overall, the psychotropic prescription variables in treatment and comparison states moved broadly in parallel pre-expansion, although stimulant trends were more ambiguous. Post-expansion, psychotropic prescriptions increased in expanding states relative to non-expanding states overall and for anti-depressants and anti-anxiety medications, while trends for other medications were less clear. However, we note that these figures capture unadjusted trends in prescriptions which, without strong and likely untenable assumptions, are not likely to capture the causal effect of Medicaid expansion. We return to formal estimation of such effects later in the manuscript.

Table 4 reports regression-based parallel trends testing. In five of six regressions we cannot reject the null hypothesis that the treatment and comparison groups followed the same trend in psychotropic prescriptions pre-expansion: $\hat{\gamma}_1$ is not statistically different from zero and is small in magnitude. The exception is the mood stabilizer regression: $\hat{\gamma}_1$ is statistically different from zero and carries a negative sign, suggesting that expanding states were trending *downward*, relative to non-expanding states, in the pre-expansion period. Because we expect Medicaid expansion to have increased, or have left unchanged, prescription rates we suspect that these pre-expansion trends work against our ability to detect effects.

4.3 Differences-in-differences regressions: Prescriptions

Table 5 reports DD results. Post-expansion, overall psychotropic prescriptions increased by 2,076 per quarter per 100,000 non-elderly adults in expanding states relative to non-expanding states, or an 22% increase relative to the baseline mean prescription rate in expanding states in the pre-expansion period (9,641).

Turning to heterogeneity by psychotropic class, Medicaid expansion increased prescriptions for anti-depressants and anti-anxiety medications. Post-expansion, anti-depressants and anti-anxiety medications prescriptions increased by 1,004 per 100,000 non-elderly adults (or 34% relative to the pre-expansion mean in expansion states) and 647 per 100,000 non-elderly adults (or 25% relative to the pre-expansion mean in expansion states) in expanding states relative to non-expanding states.

We next test whether the difference between our overall medications coefficient estimate, and the coefficient estimates for anti-depressants and anti-anxiety medications are statistically different from one another. More specifically, we use a parametric bootstrap with 1,000 repetitions to assess the statistical significance of the difference between overall and medication-specific estimates. Results suggest that overall estimate is statically different from the anti-depressants and anti-anxiety medication estimates at the 10% level or better.

We find no statistically significant change in anti-psychotic, mood stabilizer, or stimulant prescriptions. However, the coefficient estimates are positive in these regressions, providing suggestive evidence that prescriptions for these medications increased.

4.4 Differences-in-differences regressions: Prescription costs of Medicaid expansions

We next construct total, Medicaid, and non-Medicaid (e.g., patient cost-sharing)[15] payments for the psychotropic medications so that we can study the costs of increased psychotropic medications post-expansion. We consider both Medicaid and non-Medicaid payments so that we can explore financing. In particular, we can investigate the following question: did state Medicaid programs or patients bear the financial responsibility of increased prescriptions? We convert payments to 2016 terms using the previously noted GDP-deflator. We do not convert payments to rates as we do for prescriptions as we are interested in estimating

[15] We note that the non-Medicaid payment variable likely includes payments from other payers, for example, Medicare in the case of 'dual eligibles' (i.e., individuals who qualify for both Medicaid and Medicare insurance programs). Nonetheless, examining total and Medicaid payments can shed light on the financial burden shouldered by Medicaid vs. other payers, which include patients.

the overall costs of these medications to Medicaid and patients. We control for the state population age 18 to 64 years in all payment regressions, however.

Table 6 reports DD estimates of the effect of Medicaid expansion on total, Medicaid, and non-Medicaid psychotropic medication payments. Medicaid financed the majority of the psychotropic medications in the pre-expansion period. For instance, for all psychotropic medications considered here, Medicaid payments captured roughly 97% of total payments.[16]

We find no statistically significant changes in overall psychotropic medication costs (total, Medicaid, or non-Medicaid) post-expansion. However, we observe heterogeneity in effects across psychotropic classes. Post-expansion, total and Medicaid payments increased for depression (10% and 11% relative to the pre-expansion means in expansion states) and anti-anxiety (17% and 17% relative to the pre-expansion means in expansion states) medications, in expanding states relative to non-expanding states. We find no change in total and Medicaid payments for other psychotropic classes and no change in non-Medicaid payments for any psychotropic class. The magnitude of the estimates for total and Medicaid payments are comparable and non-Medicaid payments were unchanged post-expansion, suggesting that Medicaid programs – not patients – provided the majority of the financing for the increased medication use. Indeed, the estimated coefficients in the Medicaid payments regressions are often larger than the estimated coefficients in the total payments regressions. 95% confidence intervals overlap and thus we cannot reject the hypothesis that total payments increased more than Medicaid payments. Details available on request.

That we observe no statistically significant evidence that overall payments increased post-expansion in expanding states is somewhat surprising. There are several possible mechanisms for this finding. (i) Coefficient estimates are positive and standard errors are large, thus we cannot rule out the possibility that payments increased. (ii) By expanding, Medicaid programs may have gained a stronger negotiating position vis-à-vis pharmaceutical manufacturers, which allowed Medicaid to bargain lower prices, at least for some medications.[17] (iii) The newly eligible may have been directed towards less expensive medications through, for

[16] We note that the sum of Medicaid and non-Medicaid payments do not sum to total payments. SDUD documentation notes that differences are due to rounding and reporting errors. More details available on request.
[17] However, we note that Medicaid primarily, but not solely, price negotiates over manufacturer rebates and, as we discuss later in the manuscript, we do not have access to rebates in our data. Nonetheless, we argue that it is plausible that the expansions allowed at least some state Medicaid programs to better negotiate on non-rebate prices.

example, the use of generics vs. branded drugs or less costly medications within the same psychotropic class. (iv) The overall psychotropic group includes medications that increased and did not increase post-expansion; combining groups may simply attenuate effects.

5. Extensions and robustness checks

We next explore heterogeneity in Medicaid effects across state characteristics, probe the stability of our findings through a number of robustness checks, and examine whether Medicaid expansions translate into changes in mental illness.

5.1 Heterogeneity across state characteristics

The effects of Medicaid expansion on psychotropic prescriptions may vary across state features, for example patient need for mental illness treatment, access to primary care, mental illness co-morbidities, and uninsurance. These characteristics plausibly reflect differences in the potential benefits to states from Medicaid expansion and capacity of states' healthcare delivery systems to support a large-scale insurance expansion. Documenting the impact of such heterogeneity is important for policymakers in the 19 states that have not expanded Medicaid in determining whether expanding could benefit their constituents, and in the 31 states and the District of Columbia that have expanded Medicaid for understanding how to amplify expansion benefits and/or the costs of curtailing Medicaid, and for considering the distributional effects of a large policy shift across states.

We explore such heterogeneity by estimating separate regressions for states at/above and below the national median for (i) prevalence of serious mental illness among adults from the NSDUH, (ii) ratio of primary care doctors to Medicaid beneficiaries using data from the Area Resource File (ARF) and CMS, (iii) adult smoking rate from the Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance Survey,[18] (iv) adult substance use disorder (SUD) prevalence rate from the NSDUH, and (v) uninsurance rate among adults 18 to 64 years from the ACS.[19] We use 2010 data (in advance of the expansions we study) to construct these variables to avoid concerns that we are stratifying our sample on an endogenous variable.

[18] We stratify by adult smoking rate because smoking is highly correlated with mental illness. In the U.S. adults with mental illness consume 30% of all cigarettes (Substance Abuse and Mental Health Services Administration 2013). We stratify on SUD prevalence given the established co-morbidities between mental illness and SUDs (Center for Behavioral Health Statistics and Quality 2016).

[19] We rely on NSDUH data from 2009/2010 for this analysis as we use the public use state-level NSDUH which is only available at two-year intervals. Our proxy for need for mental illness treatment is defined as follows: 'Serious mental illness (SMI) is defined as having a diagnosable mental, behavioral, or emotional disorder, other than a

Results are reported in Appendix Tables 1 (treatment need), 2 (primary care access), 3 (smoking), 4 (SUD), and 5 (uninsurance). Expansion effects were generally larger (when comparing regression coefficient estimates to the pre-expansion mean in expansion states) in states with high treatment need, low primary care access, high smoking rates, low SUD rates, and high uninsurance rates. These findings are in line with our expectations, with the exception of SUD rates: we hypothesized larger effects within states with higher SUD rates. While it is beyond the scope of our study to explore the somewhat unexpected finding for our SUD stratification, we suspect that it is plausible that newly eligible enrollees suffering from SUDs may receive treatment for their SUDs and manage co-morbidities (Maclean and Saloner 2017).

5.2 Policy endogeneity

State policies are determined by the political economy within the state. An important empirical concern is therefore reverse causality. For example, state legislatures, concerned with rising mental illness or other related factors, may implement policies, such as the decision to expand Medicaid, in an attempt to reverse these trends. Such a phenomena implies that outcomes may induce changes in policies rather than policies inducing changes in outcomes.

We estimate an event study to examine reverse causality following Autor (2003). We include a series of variables for each time period before and after expansion (policy leads and lags) in Equation (1). These lead and lag variables are constructed by interacting each period indicator with an indicator for expansion states.[20] We set Q4 2013 as the index period. State-specific linear time trends are excluded from the event study following Wolfers (2006). In particular, Wolfers notes that models with dynamics (such as the leads and lags in an event study) should not include state-specific trends as such trends can muddle interpretation of the estimates of dynamic effects. We drop states with substantial expansions before 2011 (See Table 2). Results are presented graphically in Figures 7 to 12. We report the coefficient estimates and associated 95% confidence intervals that account for within-state clustering for each lead/lag.[21]

developmental or substance use disorder, that met the criteria found in the 4th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) and resulted in serious functional impairment.' Our SUD variable is based on the DSM-IV definition. Details available on request.

[20] Coded one if the state expanded Medicaid during our study period and zero otherwise.

[21] Coefficient and standard error estimates for each lead/lag variable are available on request.

The event studies do not reveal evidence of reverse causality: the coefficient estimates on the leads are small and imprecise,[22] and alternate in sign. Post-expansion for all medications, anti-depressants, anti-anxiety medications, and stimulants, the estimated coefficients are positive and generally precise. The event study results suggest that increases in prescriptions were not immediate and instead emerged over time. This pattern of results is not surprising as the newly eligible must take up Medicaid and make an appointment with a provider prior to filling and obtaining a prescription. We find no evidence that anti-psychotic or mood stabilizer medication prescriptions changed post-expansion.

5.3 Weighting

We estimated unweighted regressions, however, the economics field has not yet reached consensus regarding the use of weights in analyses seeking to estimate causal effects (Angrist and Pischke 2009; Solon, Haider, and Wooldridge 2015). Given the lack of consensus, we re-estimate Equation (1) using the state population ages 18 to 64 years as weights. Weighted results are reported in Appendix Table 6 and are not appreciably different from unweighted results. We note that, after weighting, the estimates for anti-psychotics, mood stabilizers, and stimulants rise to statistical significance (although the coefficient estimates are comparable in direction and size). We rely on unweighted regressions to be conservative.

5.4 Controlling for between-state heterogeneity

A critical concern in differences-in-differences analyses is adequately accounting for between-state differences. In Equation (1) we use state fixed effects and state-specific linear period time trends. However, this specification imposes a specific structure on the unobservables, which allowed to follow a separately linear trend for each state, and this structure could be incorrect. On the other hand, if there are no important state-level unosbervables, then Equation (1) throws away variation that could be used for identification.

We next probe the sensitivity of our results to alternative approaches to controlling for between state heterogeneity. Specifically, we rely on (i) state- and period-fixed effects, and (ii) state-specific quadratic time trends. We also include additional time-varying observable state characteristics from the ARF: doctors providing primary care, registered nurses, managed care penetration, and community mental healthcare centers. We note that some of these additional

[22] We note that some coefficients do raise to statistical significance, but these estimates carry a negative a sign and thus work against our DD findings that the expansions increased utilization.

state variables may be bad controls and urge readers to interpret findings generated in this specification with some caution (Angrist and Pischke 2009). Results are reported in Appendix Table 7 and are not appreciably different from our main findings. Estimates are generally larger (smaller) in specifications that provide less (more) control for between state heterogeneity.

5.5 Additional robustness checks

We convert our psychotropic medication variables to the rate per 100,000 individuals ages 18 to 64 as this is the primary age group targeted by the ACA Medicaid expansions we study. However, due to other changes embedded in the ACA,[23] it is plausible that older adults may be affected by Medicaid expansions. Thus, we re-estimate Equation (1) using the state population ages 18 and above as the denominator. Results (Appendix Table 8) are not appreciably different. We explore the robustness of our results to alternative functional forms: the non-transformed measure of prescriptions using OLS (i.e., we do not convert this variable to a rate per 100,000), a Poisson model, and taking the logarithm of our prescription variables and using OLS. Results are broadly robust, although estimates generated in the model that uses the non-transformed prescription variables and Poisson model are more precisely estimated (Appendix Table 9).[24] Finally, we also test alternative approaches to coding ACA Medicaid expansion states. Specifically, we re-estimate Equation (1) using the following coding schemes: (i) we drop states with substantial pre-2011 expansions following Wherry and Miller (2016), and (ii) we use a coding scheme outlined in Maclean and Saloner (2017). Results are broadly robust to the use of these alternative coding schemes and are reported in Appendix Table 10.

5.6 Mental illness

Thus far in the analysis we have examined the effect of Medicaid expansion on psychotropic medications and our results provide convincing evidence that prescriptions for these medications increased post-expansion. However, we are also interested in the effects of Medicaid expansion on mental illness. To explore such effects, we turn to the National Vital Statistics System (NVSS) and the Centers for Disease Control and Prevention's Behavioral and Risk Factor Surveillance Survey (BRFSS).

The NVSS provides the universe of deaths in the U.S. and lists the underlying cause of death. We use this information to calculate the quarterly number of suicides among adults 18 to

[23] E.g., individuals eligible for Medicaid and Medicare ('dual eligibles').
[24] We emphasize OLS rate regressions to be conservative.

64 years in each state in our sample between 2011 and 2015 (public use data for 2016 was not available at the time of writing). We convert the number of suicides to the rate per 100,000 non-elderly adults each quarter in each state. The BRFSS is a large-scale and state-representative telephone survey that is used to track health and health behaviors among U.S. residents 18 years and older. These data have been used to study Medicaid expansion effects (Simon, Soni, and Cawley 2017; Courtemanche et al. 2017). We construct mental illness proxies as the BRFSS does not include clinical measures such as Diagnostic and Statistical Manual of Mental Disorders classifications. Specifically, we use information on the number of days in the past 30 a respondent reports being in poor mental health; we look at the number of days in poor mental health and construct an indicator for being in poor mental health on all days in the last 30. While previous work has examined our first mental illness proxy (Simon, Soni, and Cawley 2017; Courtemanche et al. 2017), we are able to consider an additional year of data (2016). Moreover, we are particularly interested in the indicator for reporting poor mental health on all of the last 30 days as this measure is more likely to capture mental illness that is affected by psychotropic medication use. To the best of our knowledge, this measure has not yet been considered in the ACA Medicaid literature. We include respondents 18 to 64 years of age with household incomes of $50,000 or less (to isolate adults potentially affected by Medicaid expansion) surveyed between 2011 and 2016.[25] We aggregate the BRFSS data to the state-quarter level.

We estimate Equation (1) in the NVSS and BRFSS data. We also estimate Equation (2) to explore the ability of the NVSS and BRFSS data to satisfy the parallel trends assumption. Results are reported in Appendix Table 11A (parallel trends) and 11B (DD) for NVSS, and Appendix Table 12A (parallel trends) and 12B (DD) for BRFSS.

Our parallel trends testing provides suggestive evidence that the NVSS and BRFSS are able to satisfy the parallel trends assumption. We find no statistically significant evidence that suicides declined in expanding states relative to non-expanding states in the post-expansion period. However, we cannot rule out the possibility that the suicide rate declined by as much as 1%.[26] In the BRFSS, we find no statistically significant evidence that the number of days in poor mental health declined post-expansion, although the coefficient estimate is negative and

[25] Our analysis of Federal Poverty Levels between 2011 and 2016 suggests that our income inclusion criteria captures the majority of individuals eligible for Medicaid. Details available on request.
[26] This estimate reflects the lower bound of the 95% confidence interval surrounding the regression coefficient estimate compared to the mean rate in expanding states in the pre-expansion period. Results available on request.

implies a 3.9% decline in poor mental health days (p=0.157). Turning to our preferred proxy for mental illness, we find that, post-expansion, the probability of reporting poor mental health on all of the past 30 days declined by 0.8 percentage points (9.2%) in expanding states relative to non-expanding states and this estimate is precise (p<0.05). Overall, these analyses suggest that Medicaid expansion lead to a reduction in mental illness prevalence.

We note that our estimates of mental illness effects are reduced form and we do not study specific mechanisms that link Medicaid expansion to changes in mental illness. We hypothesize that access to and utilization of psychotropic medications played an important role but we acknowledge that other mechanisms may have also contributed. For example, Medicaid expansion improved financial security (Hu et al. 2016) and previous research shows that financial strain leads to mental illness (Maclean et al. 2015; Maclean, Webber, and French 2015)

6. Discussion

Lower income populations are at elevated risk for mental illness and are less likely to have insurance. Public insurance expansions can allow such populations to obtain insurance coverage and, in turn, receive efficacy treatment for mental illness. We examine the effect of a large-scale and recent public insurance expansion that covered mental illness services and prescription medications in the U.S. Specifically, we leverage within-state variation in Medicaid eligibility generated by provisions in the ACA 2011-2016 to study changes in Medicaid-financed prescriptions for psychotropic medications obtained in outpatient settings.

We find that post-expansion the number of Medicaid-financed psychotropic prescriptions increased by 22% in expanding states relative to non-expanding states. We identify heterogeneity in effects across psychotropic class. In particular, we find that, post-expansion, prescriptions for anti-depressants and anti-anxiety medications increased by 34% and 25% in expanding states relative to non-expanding states while anti-psychotic, mood stabilizer, and stimulant prescriptions were unchanged.

While the SDUD will not allow us to explore the factors that lie behind the differential response by psychotropic class, we hypothesize that differences in patients, providers, and/or treatment access through charity care or other programs potentially drive these differences (Garfield, Lave, and Donohue 2010). For example, patients receiving antipsychotics and mood stabilizers are likely to have more severe psychiatric disorders (e.g., schizophrenia, bipolar disorder), and face greater barriers to treatment access and medication adherence (e.g., cognitive,

functional, logistical, social) (Wilder et al. 2010). Individuals with depressive and anxiety disorders may be more able or more highly motivated to seek treatment. Because psychotropic medications require a prescription from a healthcare provider, our findings imply that newly eligible beneficiaries were able to meet with a healthcare provider within the complex outpatient mental healthcare system. This level of self-management would likely be more challenging for individuals with severe psychiatric disorders. Alternatively, a proportion of individuals with severe psychiatric disorders may have had insurance pre-expansion through other programs (e.g. disability benefits, charity care, Veteran's Affairs), thus moving pre-expansion medication access higher for this group of patients.

We identify heterogeneity in effects by state pre-ACA characteristics that proxy for patient need and system capacity. Effects generally were larger in states with high need for mental illness treatment, low access to primary care, high smoking rates, low SUD prevalence, and high uninsurance. Our analysis suggests that increases in medication prescriptions were primarily financed by Medicaid and not patients, likely due to low cost-sharing within Medicaid. Finally, we provide suggestive evidence that mental illness declined.

Our findings contribute to the growing literature investigating the effects of the ACA-related Medicaid expansions. In line with previous research we show that these expansions increased use of healthcare services (Ghosh, Simon, and Sommers 2017; Sommers et al. 2016; Miller and Wherry 2017; Wherry and Miller 2016; Maclean, Pesko, and Hill 2017; Wen et al. 2017). In particular, we document that individuals suffering from mental illnesses are also experiencing these increases in healthcare service use. Given pre-ACA literature and differences in terms of patient characteristics, insurance-elasticity of demand, and other factors, this similarity in healthcare service use gains was not *ex ante* obvious. Of particular relevance, Simon, Soni, and Cawley (2017) show that self-assessed health, which is believed to measure both mental and physical health, improved within expanding states. Our finding that access to psychotropic medications increased may provide evidence on one pathway through which the expansion lead to improved health. Moreover, we extend the ACA literature on health effects by documenting that prevalence of particularly poor self-assessed mental health (i.e., reporting poor mental health each day of the past 30 days) declined in expanding states.

Our study has limitations. (i) We lack data on patients and providers, and cannot explore issues such as whether the medicine was prescribed appropriately and if it improved mental

illness-related outcomes. (ii) The SDUD does not include manufacturer rebates to states and thus we have error in our payment variables. (iii) We have information on a single payer. (iv) Our proxies for mental illness are not ideal and estimates are intent-to-treat.

Our analysis suggests that public insurance expansions allow low-income individuals with mental illnesses to access valuable healthcare services. Reforms that curtail such access could worsen health outcomes for such individuals and, given the established negative externalities associated with mental illness (Insel 2008), have implications for broader society in terms of crime, increased healthcare costs, a less productive workforce, and so forth. In particular, reforms such as those recently proposed but that were ultimately unsuccessful by the Republican Congress (Congressional Budget Office 2017, 2017, 2017), would likely lead to large-scale reductions in the number of individuals enrolled in Medicaid. Policymakers should consider these costs to society when framing the future of Medicaid.

Table 1. Psychotropic medications

Class:	Medications
Antidepressant	Aplenzin, Budeprion, Bupropion, Celexa, Citalopram, Cymbalta, Duloxetine, Effexor, Escitalopram, Fluoxetine, Forfivo, Lexapro, Paroxetine, Paxil, Pexeva, Prozac, Rapiflux, Sarafem, Selfemra, Sertraline, Venlafaxine, Wellbutrin, and Zoloft.
Anti-anxiety	Alprazolam, Ativan, Buspar, Buspirone, Clonazepam, Klonopin, Lorazepam, Niravam, and Xanax.
Anti-psychotic	Abilify, Aripiprazole, Chlorpromazine, Clozapine, Clozaril, Etrafon, Fazaclo, Fluphenazine, Geodon, Haldol, Haloperidol, Invega, Latuda, Lurasidone, Olanzapine, Paliperidone, Perphenazine, Permitil, Prolixin, Quetiapine, Risperdal, Risperidone, Seroquel, Symbyax, Thorazine, Trilafon, Triavil, Ziprasidone, and Zyprexa.
Mood stabilizer	Depakene, Depakote, Divalproex sodium, Eskalith, Lamictal, Lamotrigine, Lithane, Lithium, Lithobid, Stavzor, Valproate sodium, and Valproic acid.
Stimulant	Adderall, Amphetamine, Aptensio, Concerta, Dexedrine, Dextroamphetamine, Dextrostat, Lisdexamfetamine, Metadate, Methylin, Methylphenidate, Procentra, Quillichew, Quillivant, Ritalin, and Vyvanse.

Notes: Data source is National Institute of Mental Health: https://www.nimh.nih.gov/health/topics/mental-health-medications/index.shtml and Medline websites (https://www.medline.com/) for specific medications (e.g., Aplenzin) embedded in the website (both websites accessed June 10th, 2017). Overall psychotropic medications include the union of the classes listed in this table. More details available on request from the corresponding author.

Table 2. State Medicaid eligibility expansions

State:	Medicaid expansion date
States with substantial expansions before 2011	
Delaware	Before 2011
District of Columbia	Before 2011
Massachusetts	Before 2011
New York	Before 2011
Vermont	Before 2011
States with substantial expansions in 2011-2014	
Arizona [a,b]	1/1/2014
Arkansas	1/1/2014
California [c]	1/1/2014
Colorado	1/1/2014
Connecticut [d]	1/1/2014
Hawaii [b]	1/1/2014
Illinois	1/1/2014
Iowa	1/1/2014
Kentucky	1/1/2014
Maryland	1/1/2014
Michigan	4/1/2014
Minnesota [d]	1/1/2014
Nevada	1/1/2014
New Hampshire	8/15/2014
New Jersey [d]	1/1/2014
New Mexico	1/1/2014
North Dakota	1/1/2014
Ohio [b]	1/1/2014
Oregon	1/1/2014
Rhode Island [b]	1/1/2014
Washington [e]	1/1/2014
West Virginia	1/1/2014
Late expansion states (post-2014)	
Alaska	9/1/2015
Indiana	2/1/2015
Montana [f]	1/1/2016
Louisiana [f]	7/1/2016
Pennsylvania	1/1/2015

Notes: Medicaid expansion dates derived from Simon et al. (2017). 'Substantial' expansions covered both parents and childless adults up to at least 100% FPL, were open to new enrollees, and had full Medicaid benefits.

[a] Expanded eligibility prior to 2011 but closed to new enrollees in 2011.

[b] Excluded, with Virginia, from the analysis due to data quality issues.

[c] From 2011 through 2013, some but not all California counties expanded eligibility, and income eligibility thresholds varied by county.

[d] Expanded eligibility prior to 2014 but with low eligibility thresholds.

[e] Expanded eligibility prior to 2014 but only to people who had previously enrolled in a state program.

[f] Non-expansion during the entire study period, 2011-2015.

Table 3. Summary statistics for expansion and non-expansion states: SDUD 2011-2013

Sample:	Expansion states	Non-expansion states	Difference (*p*-value)*
Mental illness prescriptions per 100,000			
All medications	9,641	9,169	0.1863
Depression medications	2,940	2,702	0.0621
Anxiety medications	2,598	2,327	0.0305
Ant-psychotic medications	2,034	1,839	0.0011
Mood stabilizer medications	1,239	1,496	0.0005
Stimulant medications	830	806	0.3852
State-year level characteristics			
Unemployment rate	7.643	7.204	0.0103
Poverty rate	13.80	14.82	0.0013
Family income ($)	80,104	70,357	0.0000
Age	38.07	37.50	0.0001
Female	0.505	0.507	0.0010
Male	0.495	0.493	0.0010
White	0.714	0.719	0.7317
African American	0.085	0.130	0.0000
Other race	0.082	0.055	0.0000
Hispanic	0.118	0.096	0.0205
Less than high school	0.311	0.327	0.0000
High school	0.295	0.296	0.6089
Some college	0.193	0.197	0.0192
College degree	0.201	0.180	0.0000
Democrat governor	0.565	0.098	0.0000
Max monthly TANF benefit for a family of 4 ($)	556.8	395.0	0.0000
Minimum wage (S)	8.080	7.723	0.0000
EITC (state-to-federal ratio)	0.066	0.017	0.0000
Observations	276	204	--

Notes: Unit of observation is the state-year-quarter. States with substantial expansions before 2011 excluded from the analysis (see Table 2).
*Two-tailed *t*-tests applied.

Table 4. Parallel trends test for psychotropic medication prescriptions: SDUD 2011-2013

Outcome:	**Prescriptions**
Mean value for all medications in expansion states, pre-expansion	9,641
All medications	-49
	(48)
Mean value for anti-depressant medications in expansion states, pre-expansion	2,940
Anti-depressant medications	-1
	(17)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,598
Anti-anxiety medications	-14
	(28)
Mean value for anti-psychotic medications in expansion states, pre-expansion	2,034
Anti-psychotic medications	-5
	(6)
Mean value for mood stabilizer medications in expansion states, pre-expansion	1,239
Mood stabilizer medications	-31**
	(12)
Mean value for stimulant medications in expansion states, pre-expansion	
Stimulant medications	1
	(3)
Observations	480

Notes: Unit of observation is the state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. All models control for demographics, social policies, and state and period fixed effects. Standard errors are clustered at the state level and are reported in parentheses. States with substantial expansions before 2011 excluded from the analysis (see Table 2).

***,**,* = statistically different from zero at the 1%,5%,10% level.

Table 5. Effect of Medicaid expansion on psychotropic medication prescriptions using differences-in-differences models: SDUD 2011-2016

Outcome:	**Prescriptions**
Mean value for all medications in expansion states, pre-expansion	9,641
All medications	2,076**
	(913)
Mean value for anti-depressant medications in expansion states, pre-expansion	2,940
Anti-depressant medications	1,004***
	(370)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,598
Anti-anxiety medications	647***
	(235)
Mean value for anti-psychotic medications in expansion states, pre-expansion	2,034
Anti-psychotic medications	212
	(198)
Mean value for mood stabilizer medications in expansion states, pre-expansion	1,239
Mood stabilizer medications	83
	(96)
Mean value for stimulant medications in expansion states, pre-expansion	830
Stimulant medications	130
	(86)
Observations	1,080

Notes: Unit of observation is the state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. All models control for demographics, social policies, state and period fixed effects, and state-specific linear time trends. Standard errors are clustered at the state level and are reported in parentheses.
***,**;* = statistically different from zero at the 1%,5%, 10% level.

Table 6. Effect of Medicaid expansion on psychotropic medication prescription payments using differences-in-differences models: SDUD 2011-2016

Outcome:	Total payments	Medicaid payments	Non-Medicaid payments
Mean value for all medications in expansion states, pre-expansion	$41,584,276	$40,286,436	$1,297,840
All medications	3,808,271	4,136,150	-327,880
	(3,020,319)	(2,945,167)	(240,579)
Mean value for anti-depressant medications in expansion states, pre-expansion	$4,991,200	$4,884,278	$106,922
Anti-depressant medications	521,055*	543,814*	-22,760
	(288,031)	(288,643)	(18,519)
Mean value for anti-anxiety medications in expansion states, pre-expansion	$873,554	$844,733	$28,821
Anti-anxiety medications	149,690***	143,240***	6,450
	(45,542)	(45,617)	(21,764)
Mean value for anti-psychotic medications in expansion states, pre-expansion	$27,361,517	$26,595,418	$766,099
Anti-psychotic medications	2,581,007	2,814,623	-233,617
	(2,420,894)	(2,360,065)	(143,044)
Mean value for mood stabilizer medications in expansion states, pre-expansion	$6,524,606	$6,239,572	$285,034
Mood stabilizer medications	423,470	468,847	-45,377
	(713,954)	(674,657)	(76,855)
Mean value for stimulant medications in expansion states, pre-expansion	$1,833,399	$1,722,436	$110,964
Stimulant medications	133,048	165,625	-32,577
	(207,823)	(205,416)	(20,551)
Observations	1,080	1,080	1,080

Notes: Unit of observation is the state-year-quarter. All models control for demographics, social policies, the state population ages 18 to 64 years, state and period fixed effects, and state-specific linear time trends. Standard errors are clustered at the state level and are reported in parentheses.
***,**,* = statistically different from zero at the 1%,5%, 10% level.

Appendix Table 1. Heterogeneity in Medicaid expansion effects on psychotropic medication prescriptions by need for mental illness healthcare using differences-in-differences models: SDUD 2011-2016

Outcome:	**Prescriptions**
Sample: High mental illness care need states	
Mean value for all medications in expansion states, pre-expansion	10,090
All medications	2,349***
	(694)
Mean value for anti-depressant medications in expansion states, pre-expansion	3,105
Anti-depressant medications	1,265***
	(301)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,775
Anti-anxiety medications	725***
	(205)
Mean value for anti-psychotic medications in expansion states, pre-expansion	1,969
Anti-psychotic medications	169
	(110)
Mean value for mood stabilizer medications in expansion states, pre-expansion	1,405
Mood stabilizer medications	54
	(95)
Mean value for stimulant medications in expansion states, pre-expansion	837
Stimulant medications	136**
	(57)
Observations	552
Sample: Low mental illness care need states	
Mean value for all medications in expansion states, pre-expansion	9,056
All medications	1,901
	(1,333)
Mean value for anti-depressant medications in expansion states, pre-expansion	2,725
Anti-depressant medications	703
	(553)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,369
Anti-anxiety medications	481
	(315)
Mean value for anti-psychotic medications in expansion states, pre-expansion	2,118
Anti-psychotic medications	290
	(251)
Mean value for mood stabilizer medications in expansion states, pre-expansion	1,024
Mood stabilizer medications	287*
	(160)
Mean value for stimulant medications in expansion states, pre-expansion	820
Stimulant medications	140
	(124)
Observations	528

Notes: Unit of observation is the state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. All models control for demographics, social policies, state and period fixed effects, and state-specific linear time trends. Standard errors are clustered at the state level and are reported in parentheses. Need for mental illness treatment calculated using National Survey of Drug Use and Health 2009/2010 state-level data.
***,**,* = statistically different from zero at the 1%,5%, 10% level.

Appendix Table 2. Heterogeneity in Medicaid expansion effects on psychotropic medication prescriptions by access to primary care using differences-in-differences models: SDUD 2011-2016

Outcome:	**Prescriptions**
Sample: High primary care access states	
Mean value for all medications in expansion states, pre-expansion	8,755
All medications	1,105
	(808)
Mean value for anti-depressant medications in expansion states, pre-expansion	2,812
Anti-depressant medications	600**
	(283)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,230
Anti-anxiety medications	366**
	(170)
Mean value for anti-psychotic medications in expansion states, pre-expansion	1,911
Anti-psychotic medications	27
	(173)
Mean value for mood stabilizer medications in expansion states, pre-expansion	1,028
Mood stabilizer medications	77
	(135)
Mean value for stimulant medications in expansion states, pre-expansion	773
Stimulant medications	36
	(77)
Observations	528
Sample: Low primary care access states	
Mean value for all medications in expansion states, pre-expansion	11,018
All medications	1,851
	(1,157)
Mean value for anti-depressant medications in expansion states, pre-expansion	3,138
Anti-depressant medications	998*
	(507)
Mean value for anti-anxiety medications in expansion states, pre-expansion	3,171
Anti-anxiety medications	697**
	(320)
Mean value for anti-psychotic medications in expansion states, pre-expansion	2,225
Anti-psychotic medications	204
	(224)
Mean value for mood stabilizer medications in expansion states, pre-expansion	1,567
Mood stabilizer medications	-165
	(128)
Mean value for stimulant medications in expansion states, pre-expansion	917
Stimulant medications	117
	(99)
Observations	552

Notes: Unit of observation is the state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. All models control for demographics, social policies, state and period fixed effects, and state-specific linear time trends. Standard errors are clustered at the state level and are reported in parentheses. Access to primary care calculated using CMS and Area Resource File 2010 data.

***,**,* = statistically different from zero at the 1%,5%, 10% level.

Appendix Table 3. Heterogeneity in Medicaid expansion effects on psychotropic medication prescriptions by smoking status using differences-in-differences models: SDUD 2011-2016

Outcome:	**Prescriptions**
Sample: High smoking rate states	
Mean value for all medications in expansion states, pre-expansion	10,445
All medications	2,594**
	(1,000)
Mean value for anti-depressant medications in expansion states, pre-expansion	3,007
Anti-depressant medications	1,261***
	(405)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,897
Anti-anxiety medications	864***
	(288)
Mean value for anti-psychotic medications in expansion states, pre-expansion	2,179
Anti-psychotic medications	240
	(163)
Mean value for mood stabilizer medications in expansion states, pre-expansion	1,471
Mood stabilizer medications	83
	(121)
Mean value for stimulant medications in expansion states, pre-expansion	892
Stimulant medications	146*
	(77)
Observations	576
Sample: Low smoking rate states	
Mean value for all medications in expansion states, pre-expansion	8,763
All medications	2,198*
	(1,191)
Mean value for anti-depressant medications in expansion states, pre-expansion	2,866
Anti-depressant medications	1,007*
	(526)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,273
Anti-anxiety medications	452
	(308)
Mean value for anti-psychotic medications in expansion states, pre-expansion	1,876
Anti-psychotic medications	404*
	(213)
Mean value for mood stabilizer medications in expansion states, pre-expansion	986
Mood stabilizer medications	130
	(148)
Mean value for stimulant medications in expansion states, pre-expansion	762
Stimulant medications	204*
	(104)
Observations	504

Notes: Unit of observation is the state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. All models control for demographics, social policies, state and period fixed effects, and state-specific linear time trends. Standard errors are clustered at the state level and are reported in parentheses. Smoking rates calculated using Behavioral Risk Factor Surveillance Survey 2010 data.
***,**,* = statistically different from zero at the 1%,5%,10% level.

Appendix Table 4. Heterogeneity in Medicaid expansion effects on psychotropic medication prescriptions by SUD prevalence using differences-in-differences models: SDUD 2011-2016

Outcome:	**Prescriptions**
Sample: High SUD prevalence states	
Mean value for all medications in expansion states, pre-expansion	8,384
All medications	-317
	(886)
Mean value for anti-depressant medications in expansion states, pre-expansion	2,611
Anti-depressant medications	190
	(362)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,193
Anti-anxiety medications	8
	(189)
Mean value for anti-psychotic medications in expansion states, pre-expansion	1,859
Anti-psychotic medications	-293
	(233)
Mean value for mood stabilizer medications in expansion states, pre-expansion	986
Mood stabilizer medications	-132
	(129)
Mean value for stimulant medications in expansion states, pre-expansion	735
Stimulant medications	-90
	(92)
Observations	528
Sample: Low SUD prevalence states	
Mean value for all medications in expansion states, pre-expansion	11,012
All medications	3,637***
	(1,023)
Mean value for anti-depressant medications in expansion states, pre-expansion	3,298
Anti-depressant medications	1,597***
	(453)
Mean value for anti-anxiety medications in expansion states, pre-expansion	3,041
Anti-anxiety medications	1,034***
	(307)
Mean value for anti-psychotic medications in expansion states, pre-expansion	2,224
Anti-psychotic medications	463***
	(154)
Mean value for mood stabilizer medications in expansion states, pre-expansion	1,516
Mood stabilizer medications	278*
	(136)
Mean value for stimulant medications in expansion states, pre-expansion	933
Stimulant medications	264***
	(76)
Observations	552

Notes: Unit of observation is the state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. All models control for demographics, social policies, state and period fixed effects, and state-specific linear time trends. Standard errors are clustered at the state level and are reported in parentheses. SUD prevalence rates calculated using National Survey of Drug Use and Health 2009/2010 state-level data.
***,**,* = statistically different from zero at the 1%,5%,10% level.

Appendix Table 5. Heterogeneity in Medicaid expansion effects on psychotropic medication prescriptions by uninsurance rate using differences-in-differences models: SDUD 2011-2016

Outcome:	**Prescriptions**
Sample: High uninsurance rate states	
Mean value for all medications in expansion states, pre-expansion	9,355
All medications	2,742**
	(1,088)
Mean value for anti-depressant medications in expansion states, pre-expansion	2,784
Anti-depressant medications	1,302***
	(447)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,572
Anti-anxiety medications	840***
	(274)
Mean value for anti-psychotic medications in expansion states, pre-expansion	1,972
Anti-psychotic medications	288
	(237)
Mean value for mood stabilizer medications in expansion states, pre-expansion	1,202
Mood stabilizer medications	147
	(97)
Mean value for stimulant medications in expansion states, pre-expansion	825
Stimulant medications	165
	(106)
Observations	600
Sample: Low uninsurance rate states	
Mean value for all medications in expansion states, pre-expansion	10,012
All medications	1,918**
	(690)
Mean value for anti-depressant medications in expansion states, pre-expansion	3,142
Anti-depressant medications	842***
	(222)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,633
Anti-anxiety medications	461**
	(181)
Mean value for anti-psychotic medications in expansion states, pre-expansion	2,115
Anti-psychotic medications	269*
	(137)
Mean value for mood stabilizer medications in expansion states, pre-expansion	1,287
Mood stabilizer medications	189
	(160)
Mean value for stimulant medications in expansion states, pre-expansion	835
Stimulant medications	158**
	(64)
Observations	480

Notes: Unit of observation is the state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. All models control for demographics, social policies, state and period fixed effects, and state-specific linear time trends. Standard errors are clustered at the state level and are reported in parentheses. Uninsurance rates calculated using the American Community Survey 2010 data.

***,**,* = statistically different from zero at the 1%,5%,10% level.

Appendix Table 6. Effect of Medicaid expansion on psychotropic medication prescriptions using differences-in-differences models using population weights: SDUD 2011-2016

Outcome:	**Prescriptions**
Mean value for all medications in expansion states, pre-expansion	8,928
All medications	2,538***
	(819)
Mean value for anti-depressant medications in expansion states, pre-expansion	2,720
Anti-depressant medications	1,111***
	(344)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,440
Anti-anxiety medications	685***
	(196)
Mean value for anti-psychotic medications in expansion states, pre-expansion	2,032
Anti-psychotic medications	369**
	(166)
Mean value for mood stabilizer medications in expansion states, pre-expansion	956
Mood stabilizer medications	182*
	(91)
Mean value for stimulant medications in expansion states, pre-expansion	780
Stimulant medications	191**
	(77)
Observations	1,080

Notes: State populations ages 18 to 64 years serve as the weights. Unit of observation is the state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. All models control for demographics, social policies, state and period fixed effects, and state-specific linear time trends. Standard errors are clustered at the state level and are reported in parentheses.

***,**,* = statistically different from zero at the 1%,5%,10% level.

Appendix Table 7. Effect of Medicaid expansion on psychotropic medication prescriptions using differences-in-differences models with different controls for between-state differences: SDUD 2011-2016

Model:	**(1)**	**(2)**	**(3)**	**(4)**
Mean value for all medications in expansion states, pre-expansion	9,641	9,641	9,641	9,641
All medications	2,076**	2,070**	1,517*	1,618**
	(913)	(948)	(872)	(642)
Mean value for anti-depressant medications in expansion states, pre-expansion	2,940	2,940	2,940	2,940
Anti-depressant medications	1,004***	1,240***	798**	840***
	(370)	(387)	(358)	(292)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,598	2,598	2,598	2,598
Anti-anxiety medications	647***	702***	519**	570***
	(235)	(222)	(211)	(198)
Mean value for anti-psychotic medications in expansion states, pre-expansion	2,034	2,034	2,034	2,034
Anti-psychotic medications	212	141	119	125
	(198)	(193)	(176)	(116)
Mean value for mood stabilizer medications in expansion states, pre-expansion	1,239	1,239	1,239	1,239
Mood stabilizer medications	83	-150	-7	-5
	(96)	(139)	(105)	(77)
Mean value for stimulant medications in expansion states, pre-expansion	830	830	830	830
Stimulant medications	130	137	88	88
	(86)	(89)	(78)	(54)
Observations	1,080	1,080	1,080	1,080

Notes: The outcome variable in each regression is the number of prescription fills and refills. Unit of observation is the state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. Standard errors are clustered at the state level and are reported in parentheses. Model (1) controls for demographics, social policies, state and period fixed effects, and state-specific linear time trends (baseline mode, see Equation [1] in the manuscript text for more details). Model (2) controls for demographics, social policies, and state and period fixed effects. Model (3) controls for demographics, social policies, state and period fixed effects, and state-specific quadratic time trends. Model (4) controls for demographics, social policies, state and period fixed effects, state-specific linear time trends, and extended set of state-level controls.

***,**,* = statistically different from zero at the 1%,5%,10% level.

Appendix Table 8. Effect of Medicaid expansion on psychotropic medication prescriptions using differences-in-differences models using the population 18 years and older as the denominator: SDUD 2011-2016

Outcome:	**Prescriptions**
Mean value for all medications in expansion states, pre-expansion	7,870
All medications	1,659**
	(719)
Mean value for anti-depressant medications in expansion states, pre-expansion	2,400
Anti-depressant medications	803***
	(292)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,119
Anti-anxiety medications	514***
	(184)
Mean value for anti-psychotic medications in expansion states, pre-expansion	1,664
Anti-psychotic medications	170
	(157)
Mean value for mood stabilizer medications in expansion states, pre-expansion	1,009
Mood stabilizer medications	68
	(76)
Mean value for stimulant medications in expansion states, pre-expansion	678
Stimulant medications	104
	(68)
Observations	1,080

Notes: Unit of observation is the state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 years and older. All models control for demographics, social policies, state and period fixed effects, and state-specific linear time trends. Standard errors are clustered at the state level and are reported in parentheses. ***,**,* = statistically different from zero at the 1%,5%,10% level.

Appendix Table 9. Effect of Medicaid expansion on psychotropic medication prescriptions using differences-in-differences models using alternative Medicaid expansion coding schemes: SDUD 2011-2016

Medicaid expansion coding scheme:	**Wherry & Miller**	**Maclean & Saloner**
Mean value for all medications in expansion states, pre-expansion	9,641	10,774
All medications	2,262***	1,606
	(813)	(1,012)
Mean value for anti-depressant medications in expansion states, pre-expansion	2,940	3,319
Anti-depressant medications	1,078***	787*
	(329)	(411)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,598	2,932
Anti-anxiety medications	702***	517*
	(217)	(259)
Mean value for anti-psychotic medications in expansion states, pre-expansion	2,034	2,164
Anti-psychotic medications	204	118
	(176)	(216)
Mean value for mood stabilizer medications in expansion states, pre-expansion	1,239	1,452
Mood stabilizer medications	146*	102
	(86)	(97)
Mean value for stimulant medications in expansion states, pre-expansion	830	907
Stimulant medications	131*	82
	(77)	(94)
Observations	960	1,080

Notes: Unit of observation is the state-year-quarter. See text for a discussion of the alternative Medicaid expansion coding schemes. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. All models control for demographics, social policies, state and period fixed effects, and state-specific linear time trends. Standard errors are clustered at the state level and are reported in parentheses.

***,**;* = statistically different from zero at the 1%,5%, 10% level.

Appendix Table 10. Effect of Medicaid expansion on psychotropic medication prescriptions using differences-in-differences models using alternative functional forms: SDUD 2011-2016

Functional form:	Non-transformed LS	Logged model	Poisson model
Mean value for all medications in expansion states, pre-expansion	356,035	9,641	356,035
All medications	61,719***	0.095	73,179***
	(19,370)	(0.080)	(25,422)
Mean value for anti-depressant medications in expansion states, pre-expansion	108,453	2,940	108,453
Anti-depressant medications	29,439***	0.195**	31,268***
	(8,140)	(0.082)	(9,643)
Mean value for anti-anxiety medications in expansion states, pre-expansion	97,321	2,598	97,321
Anti-anxiety medications	19,141***	0.170**	23,804***
	(6,492)	(0.082)	(6,716)
Mean value for anti-psychotic medications in expansion states, pre-expansion	81,017	2,034	81,017
Anti-psychotic medications	6,962**	-0.008	10,031**
	(2,594)	(0.088)	(4,628)
Mean value for mood stabilizer medications in expansion states, pre-expansion	38,127	1,239	38,127
Mood stabilizer medications	2,250	-0.016	3,666
	(2,806)	(0.082)	(3,269)
Mean value for stimulant medications in expansion states, pre-expansion	31,118	830	31,118
Stimulant medications	3,927***	0.045	5,023**
	(1,138)	(0.082)	(2,253)
Observations	1,080	1,080	1,080

Notes: Unit of observation is the state-year-quarter. Non-transformed LS regression controls for the state population ages 18 to 64 years. Logged model outcomes are converted to a rate per 100,000 persons 18 to 64 years and the natural logarithm transformation is applied to this rate. Average marginal effects are reported in Poisson models rather than beta coefficients, and the state population ages 18 to 64 years is the exposure variable. All models control for demographics, social policies, state and period fixed effects, and state-specific linear time trends. Standard errors are clustered at the state level and are reported in parentheses.
***,**;* = statistically different from zero at the 1%,5%, 10% level.

Appendix Table 11A. Parallel trends test for the suicide rate per 100,00 non-elderly: NVSS 2011-2013

Outcome:	**Suicide rate per 100,000 18-64 year olds**
Mean value in expansion states, pre-expansion	2.885
Treat*time	-0.003
	(0.007)
Observations	552

Notes: Unit of observation is the state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. All models control for demographics, social policies, and state and period fixed effects. Standard errors are clustered at the state level and are reported in parentheses. States with substantial expansions before 2011 excluded from the analysis (see Table 2).
***,**,* = statistically different from zero at the 1%,5%,10% level.

Appendix Table 11B. Effect of Medicaid expansion on the suicide rate per 100,00 non-elderly using differences-in-differences models: NVSS 2011-2015

Outcome:	**Suicide rate per 100,000 18-64 year olds**
Mean value in expansion states, pre-expansion	2.885
Expand	0.086
	(0.058)
Observations	1,020

Notes: Unit of observation is the state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. All models control for demographics, social policies, state and period fixed effects, and state-specific linear time trends. Standard errors are clustered at the state level and are reported in parentheses.
***,**;* = statistically different from zero at the 1%,5%, 10% level.

Appendix Table 12A. Parallel trends test for days in poor mental health in the past 30: BRFSS 2011-2013

Outcome:	Days in poor mental health of past 30	Poor mental health all days of past 30
Mean value/proportion in expansion states, pre-expansion	5.441	0.087
Treat*time	-0.004	0.000
	(0.016)	(0.000)
Observations	552	552

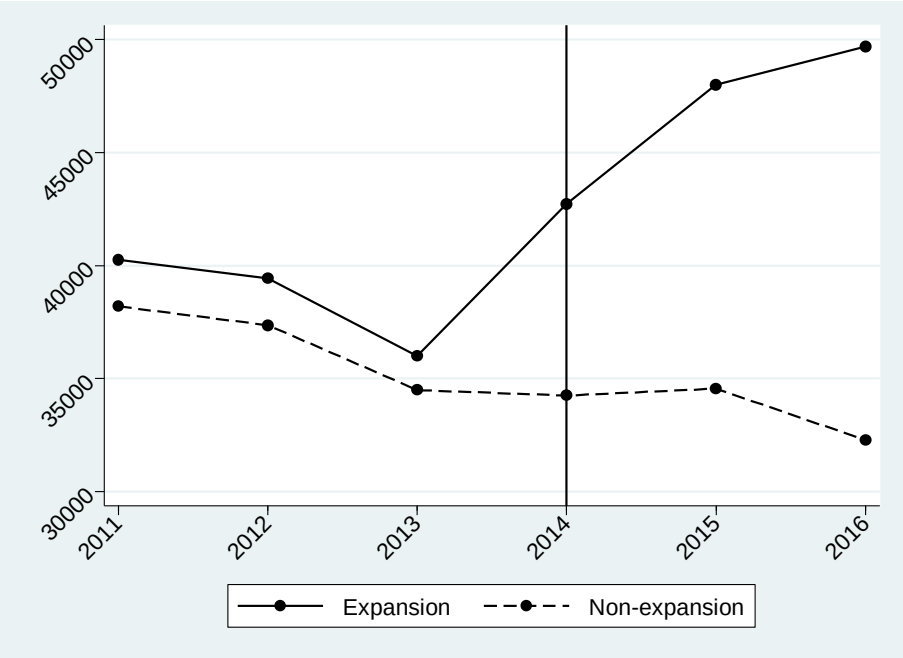
Notes: Unit of observation is the state-year-quarter. All models control for demographics, social policies, state population, and state and period fixed effects. Standard errors are clustered at the state level and are reported in parentheses. States with substantial expansions before 2011 excluded from the analysis (see Table 2).
***,**,* = statistically different from zero at the 1%,5%,10% level.

Appendix Table 12B. Effect of Medicaid expansion on days in poor mental health in the past 30 using differences-in-differences models: BRFSS 2011-2016

Outcome:	Days in poor mental health of past 30	Poor mental health all days of past 30
Mean value/proportion in expansion states, pre-expansion	5.441	0.087
Expand	-0.214	-0.008**
	(0.117)	(0.004)
Observations	1,224	1,224

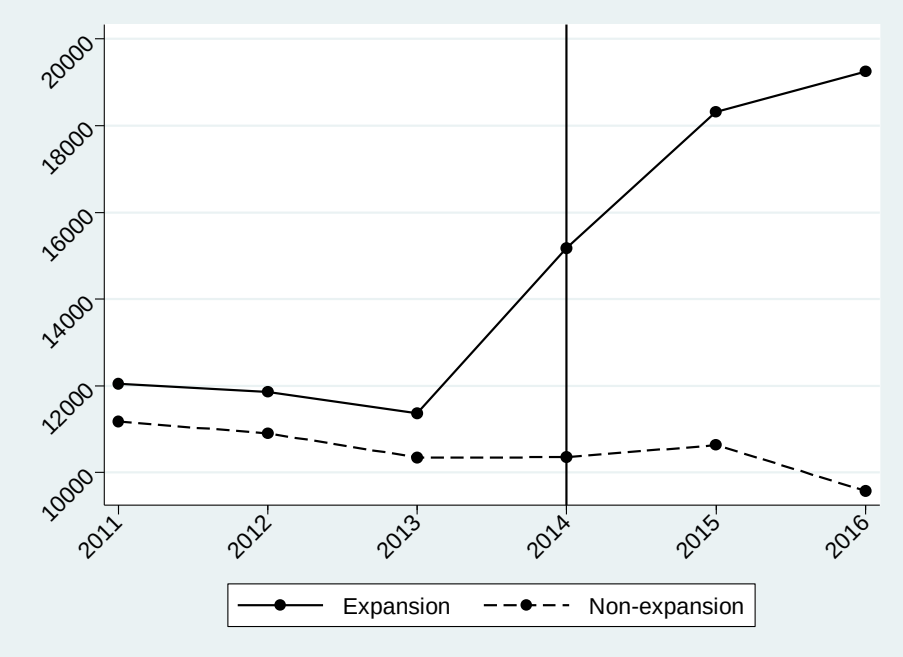
Notes: Unit of observation is the state-year-quarter. All models control for demographics, social policies, state population, state and period fixed effects, and state-specific linear time trends. Standard errors are clustered at the state level and are reported in parentheses.
***,**;* = statistically different from zero at the 1%,5%, 10% level.

Figure 1. Trends in all psychotropic medication prescriptions in expansion and non-expansion states: SDUD 2011-2016



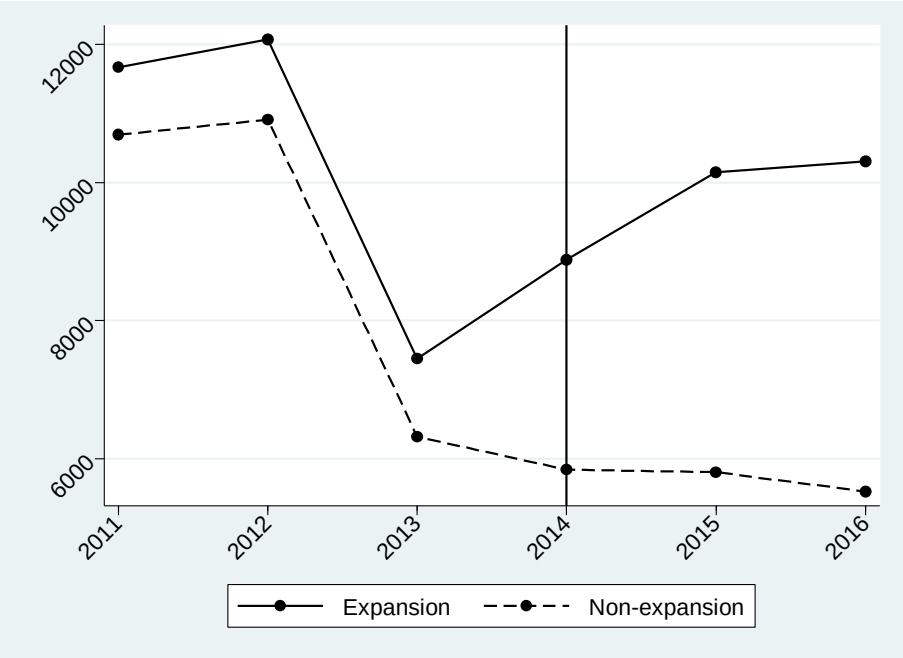
Notes: Data is aggregated to the treatment-year level.

Figure 2. Trends in anti-depressant medication prescriptions in expansion and non-expansion states: SDUD 2011-2016



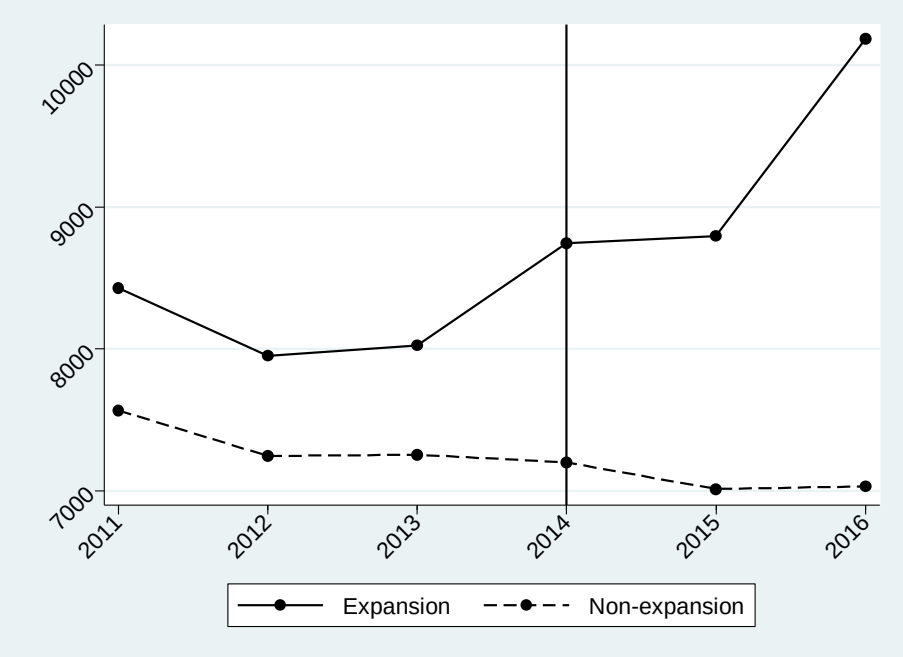
Notes: Data is aggregated to the treatment-year level.

Figure 3. Trends in anti-anxiety medication prescriptions in expansion and non-expansion states: SDUD 2011-2016



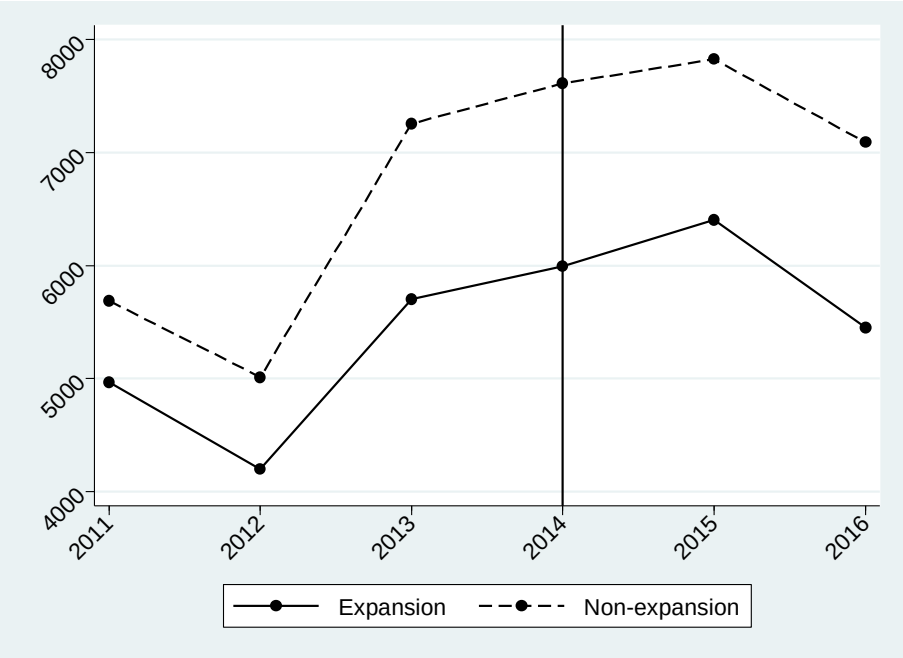
Notes: Data is aggregated to the treatment-year level.

Figure 4. Trends in anti-psychotic medication prescriptions in expansion and non-expansion states: SDUD 2011-2016



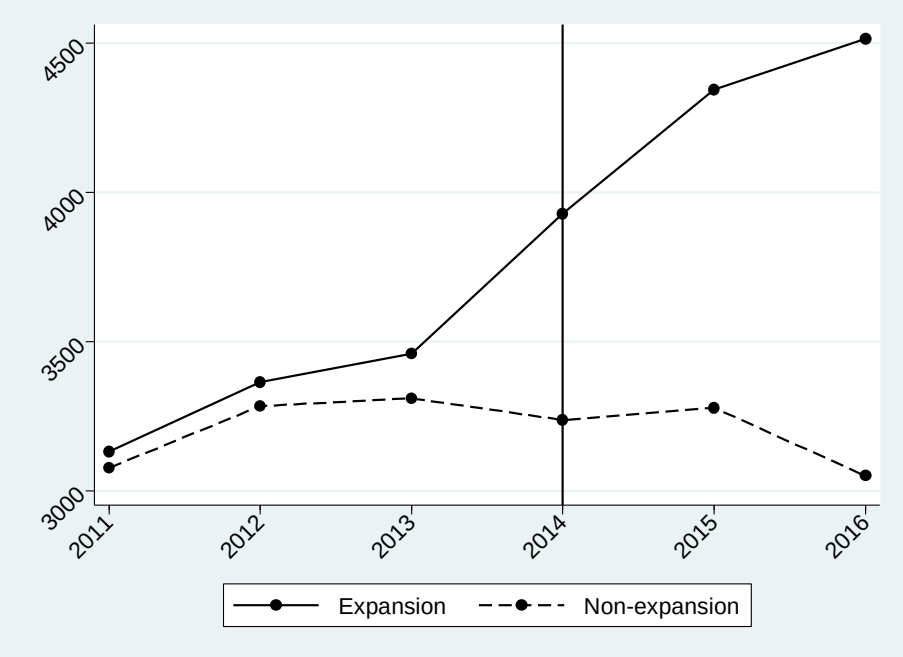
Notes: Data is aggregated to the treatment-year level.

Figure 5. Trends in mood stabilizer medication prescriptions in expansion and non-expansion states: SDUD 2011-2016



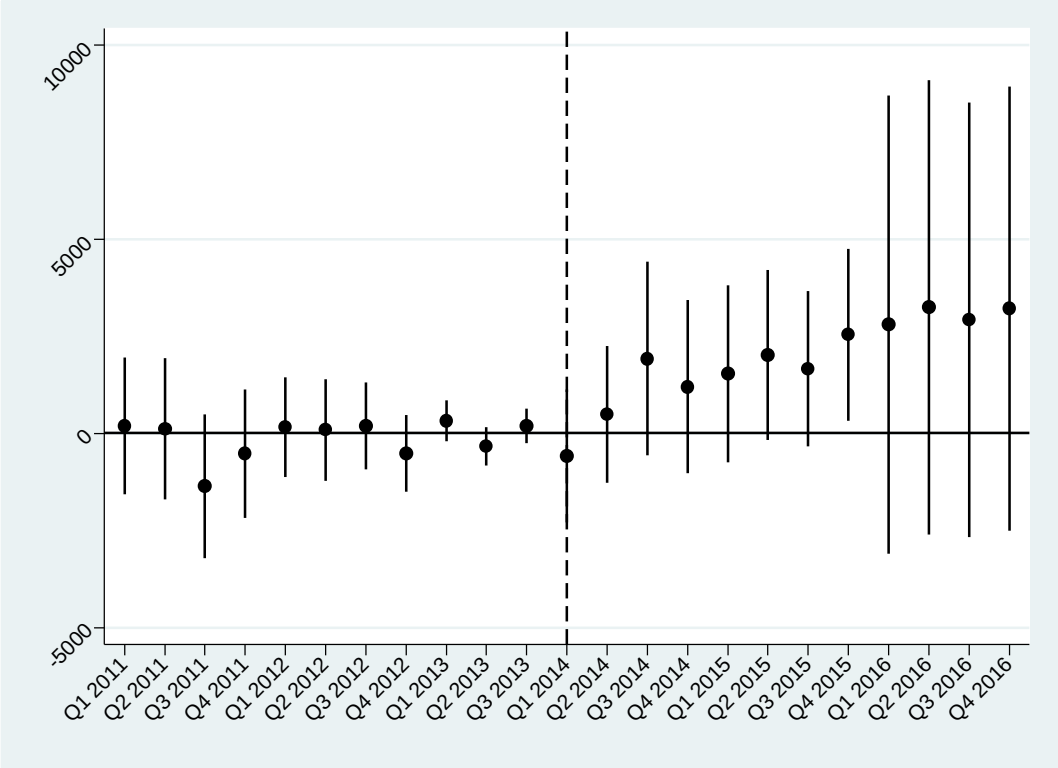
Notes: Data is aggregated to the treatment-year level.

Figure 6. Trends in stimulant medication prescriptions in expansion and non-expansion states: SDUD 2011-2016



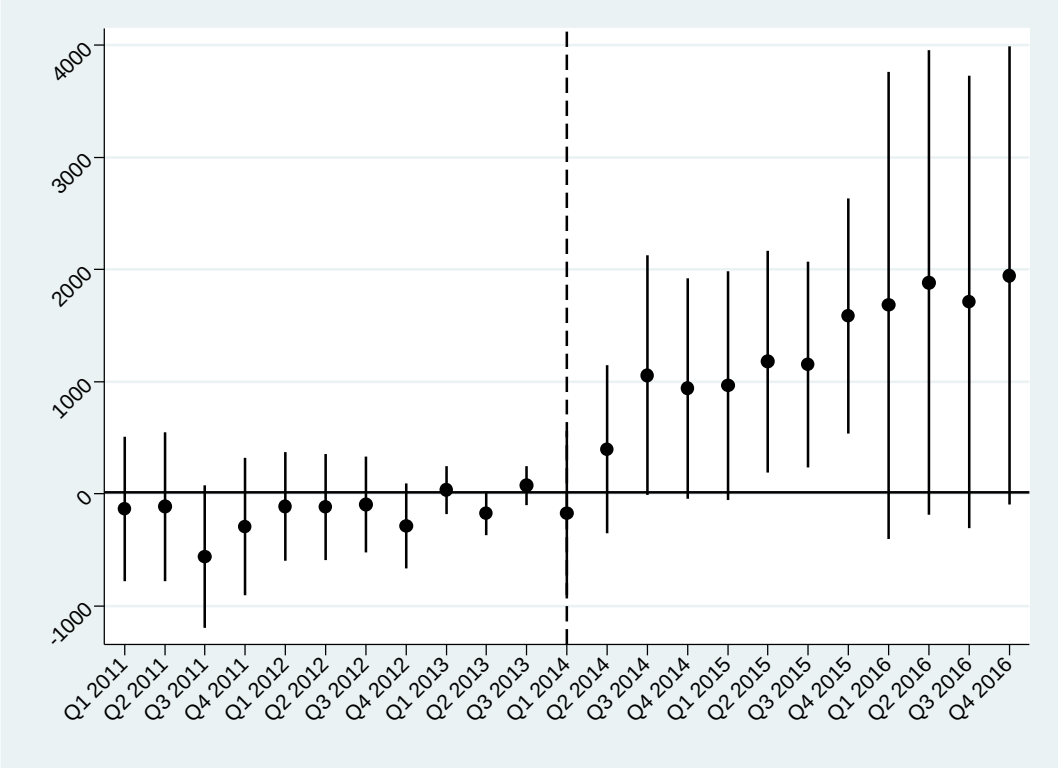
Notes: Data is aggregated to the treatment-year level.

Figure 7. Effect of Medicaid expansions on psychotropic medication prescriptions per 100,000 using an event study model: SDUD 2011-2016



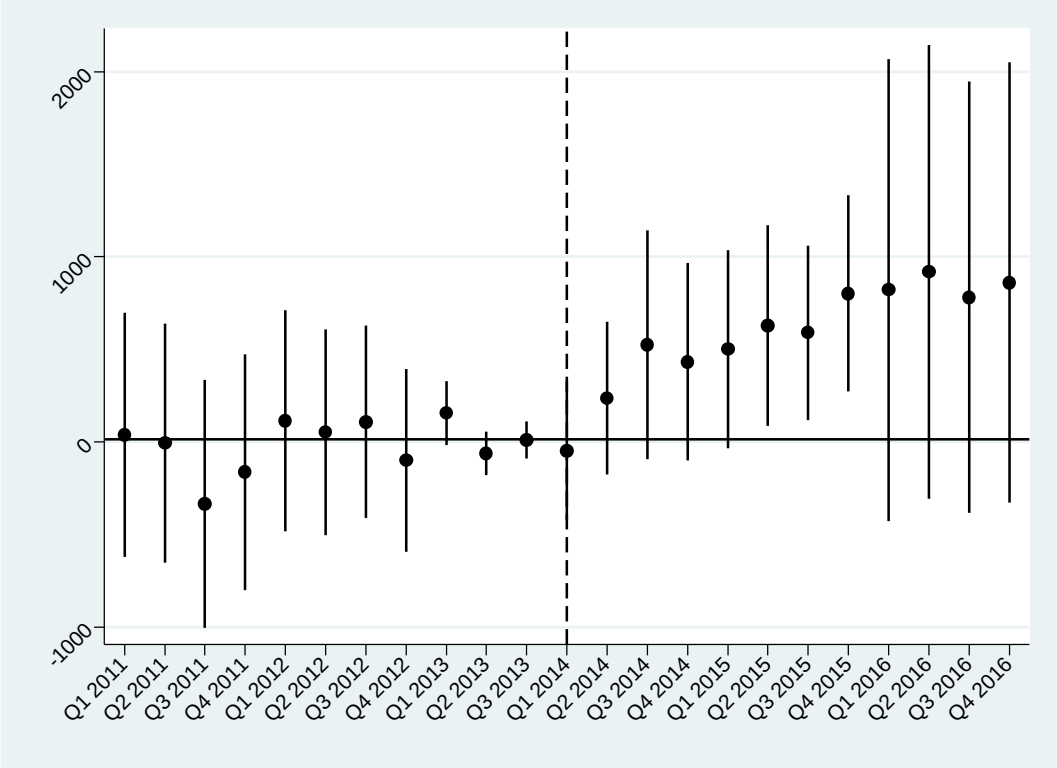
Notes: Unit of observation is a state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. Event study dummy variables include each year-quarter cell between Q1 2011 and Q4 2016, the omitted category is Q4 2013. All models control for demographics, social policies, and state and period fixed effects. 95% confidence intervals account for state-level clustering and are reported in vertical bars. States with substantial expansions before 2011 excluded from the analysis (see Table 2). N=960.

Figure 8. Effect of Medicaid expansions on anti-depressant medication prescriptions per 100,000 using an event study model: SDUD 2011-2016



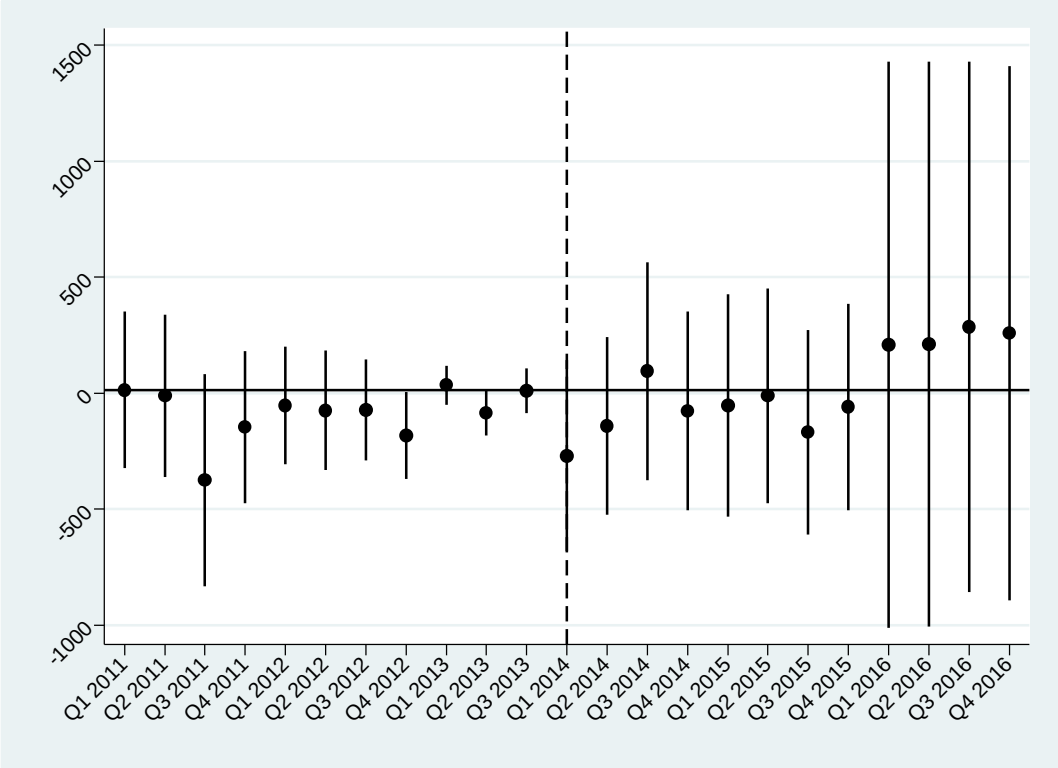
Notes: Unit of observation is a state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. Event study dummy variables include each year-quarter cell between Q1 2011 and Q4 2016, the omitted category is Q4 2013. All models control for demographics, social policies, and state and period fixed effects. 95% confidence intervals account for state-level clustering and are reported in vertical bars. States with substantial expansions before 2011 excluded from the analysis (see Table 2). N=960.

Figure 9. Effect of Medicaid expansions on anti-anxiety medication prescriptions per 100,000 using an event study model: SDUD 2011-2016



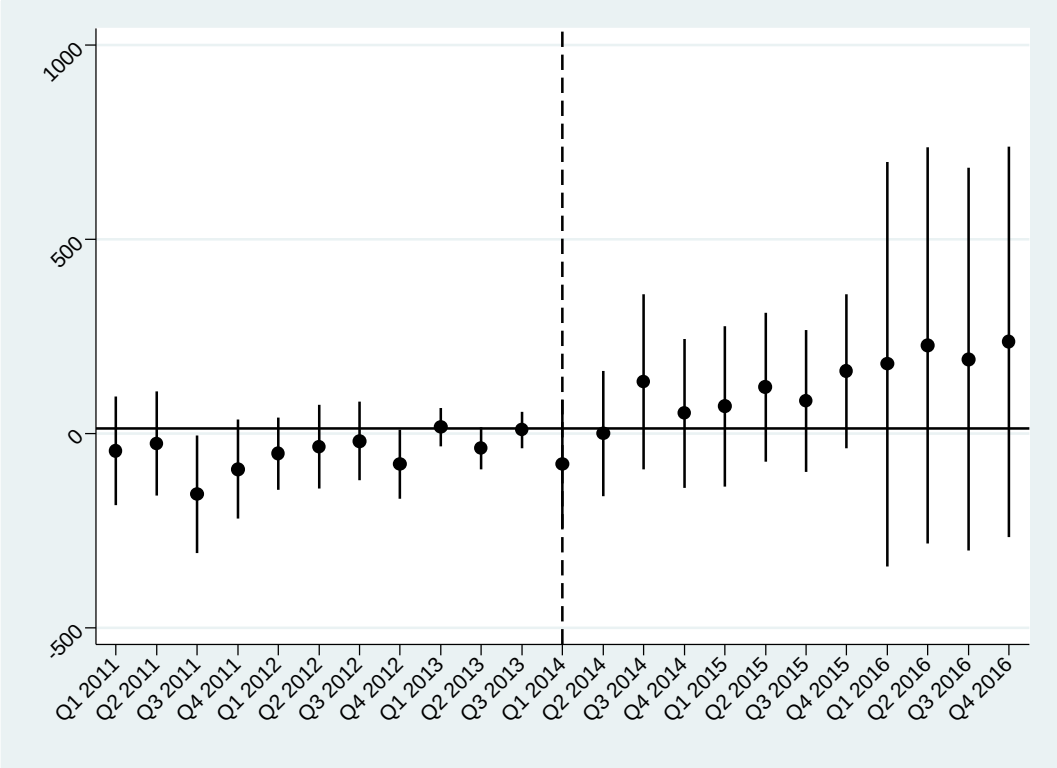
Notes: Unit of observation is a state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. Event study dummy variables include each year-quarter cell between Q1 2011 and Q4 2016, the omitted category is Q4 2013. All models control for demographics, social policies, and state and period fixed effects. 95% confidence intervals account for state-level clustering and are reported in vertical bars. States with substantial expansions before 2011 excluded from the analysis (see Table 2). N=960.

Figure 10. Effect of Medicaid expansions on anti-psychotic medication prescriptions per 100,000 using an event study model: SDUD 2011-2016



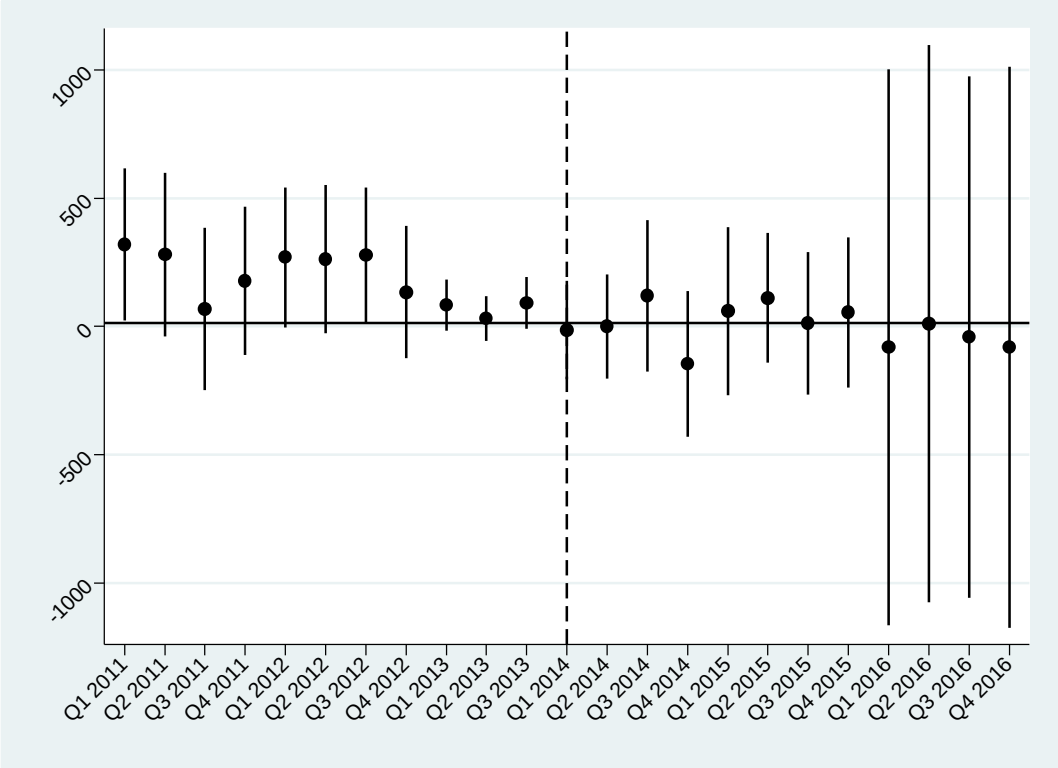
Notes: Unit of observation is a state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. Event study dummy variables include each year-quarter cell between Q1 2011 and Q4 2016, the omitted category is Q4 2013. All models control for demographics, social policies, and state and period fixed effects. 95% confidence intervals account for state-level clustering and are reported in vertical bars. States with substantial expansions before 2011 excluded from the analysis (see Table 2). N=960.

Figure 11. Effect of Medicaid expansions on mood stabilizer medication prescriptions per 100,000 using an event study model: SDUD 2011-2016



Notes: Unit of observation is a state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. Event study dummy variables include each year-quarter cell between Q1 2011 and Q4 2016, the omitted category is Q4 2013. All models control for demographics, social policies, and state and period fixed effects. 95% confidence intervals account for state-level clustering and are reported in vertical bars. States with substantial expansions before 2011 excluded from the analysis (see Table 2). N=960.

Figure 12. Effect of Medicaid expansions on stimulant medication prescriptions per 100,000 using an event study model: SDUD 2011-2016



Notes: Unit of observation is a state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. Event study dummy variables include each year-quarter cell between Q1 2011 and Q4 2016, the omitted category is Q4 2013. All models control for demographics, social policies, and state and period fixed effects. 95% confidence intervals account for state-level clustering and are reported in vertical bars. States with substantial expansions before 2011 excluded from the analysis (see Table 2). N=960.

Supplementary Table 1. Effect of Medicaid expansion on mental illness medication prescriptions using differences-in-differences models: SDUD 2011-2015

Outcome:	**Prescriptions**
Mean value for all medications in expansion states, pre-expansion	9,641
All medications	1,946***
	(542)
Mean value for anti-depressant medications in expansion states, pre-expansion	2,940
Anti-depressant medications	966***
	(240)
Mean value for anti-anxiety medications in expansion states, pre-expansion	2,598
Anti-anxiety medications	552***
	(159)
Mean value for anti-psychotic medications in expansion states, pre-expansion	2,034
Anti-psychotic medications	196**
	(81)
Mean value for mood stabilizer medications in expansion states, pre-expansion	1239
Mood stabilizer medications	106
	(75)
Mean value for stimulant medications in expansion states, pre-expansion	830
Stimulant medications	126***
	(39)
Observations	900

Notes: Unit of observation is the state-year-quarter. All outcomes are converted to a rate per 100,000 persons 18 to 64 years. All models control for demographics, social policies, state and period fixed effects, and state-specific linear time trends. Standard errors are clustered at the state level and are reported in parentheses.
***,**;* = statistically different from zero at the 1%,5%, 10% level.

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