Substance Abuse Treatment and Motor Vehicle Fatalities

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Abstract

The danger of alcohol- and drug-impaired driving implies that policies that reduce substance abuse can save lives. We study this issue in small US counties where access to substance abuse treatment can be measured directly through the presence of treatment facilities. We find that placing an additional treatment clinic in a county reduces the number of alcohol-related motor vehicle fatalities by 15%. An additional outpatient clinic, which specializes in treating the local population, reduces the overall number of alcohol-related deaths by 26%. In the counties that we study, this reduction in alcohol-related accidents saves 0.66 lives per county per year.

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1 Introduction

In recent years, motor vehicle accidents have lead to over 40,000 deaths annually in the United States, and alcohol-related accidents account for about 40% of these deaths. Legally drunk drivers are much more dangerous on the road than sober drivers,[1] so considerable effort has been devoted to reducing the incidence of alcohol-impaired driving. Policies targeting drunk driving include alcohol taxes, increases in the legal drinking age, educational efforts, more stringent blood alcohol content (BAC) limits, and increased punishments for those arrested for driving under the influence of alcohol (DUI).[2] In this paper we evaluate the impact of an additional policy instrument for reducing the incidence of drunk driving: the supply of substance abuse treatment (SAT).

In 2006, an estimated 22.6 million US residents were classified with substance dependence or substance abuse problems. Only 30% of this group, however, received treatment for alcohol abuse or drug addiction.[3] There is abundant evidence that SAT reduces drug and alcohol abuse, specifically among heavy users.[4] A reduction in dangerous driving behavior is just one of the positive effects of successful SAT; others include improvements in physical health, employment performance, and happiness at home. Substance abuse treatment also has the advantage of being a lower-cost approach to consumption reduction compared to criminal justice interventions in alcohol and drug abuse.[5]

In order to assess the impact of increased SAT on reductions in traffic fatalities, we would ideally observe data on: the individuals who desire or require treatment, which individuals do and do not receive treatment, the subsequent drug and alcohol consumption of the treated

[1] See Levitt and Porter (2001).

[2] Benson, Rasmussen and Mast (1999) discuss the effectiveness of these policies.

[3] National Survey on Drug Use and Health (2006).

[4] For examples, see Lu and McGuire (2002) or Saffer, Chaloupka and Dave (2002). Prendergast, Podus, Chang, and Urada (2002) perform a meta-analysis on the "effectiveness of treatment" literature (78 studies) and show that clients who receive treatment have significantly better outcomes than those who do not receive treatment.

[5] Specifically, substance abuse treatment is believed to be more cost-effective than punishment. A prominent RAND study (Rydell and Everingham, 1994) finds that treatment is 7 times more cost effective than domestic law enforcement, 10 times more effective than interdiction, and 23 times more effective than the "source control" method (attacking drug supply abroad). Cartwright (2000) provides a detailed review of the literature on cost-benefit analysis of treatment and concludes that although there is a great deal of variation in the literature, the general persistent finding is that the benefit of substance abuse treatment outweighs the costs.

and untreated, and finally the differences in driving behavior of the treated and untreated populations. Data at this level of detail on substance abuse, treatment, and driving are simply unavailable, so in this paper we employ coarser measures of SAT in the US.[6] We observe the numbers of SAT clinics and traffic fatalities in non-metropolitan US counties, where the extent of treatment can be measured by the number of local SAT clinics. We effectively assume that an increase in the number of SAT clinics reduces the costs or inconvenience for the local population to receive treatment. As more individuals receive treatment, the safety of driving behavior increases on local roads. Our approach, therefore, is conservative in the sense that we do not capture the opportunity of one county's residents to take treatment in a neighboring county, or the beneficial impact of successful SAT on driving in areas other than a person's home county.

We face a considerable challenge in establishing a causal link between SAT and traffic fatalities. Even if increasing SAT truly reduces dangerous driving, many factors that are difficult or impossible to observe can interfere with correctly making this inference. For example, counties with populations that, in unobserved ways, are especially prone to alcohol and drug abuse could have both a high rate of auto fatalities and a large number of SAT clinics. Alternatively, it could be the case that some counties are particularly aggressive in treating substance-related disorders and minimizing their impact on drivers, and these counties would have both more SAT clinics and fewer deaths. In addition to issues related to local unobservables, the nature of SAT creates challenges that are not present in many alternative alcohol-related policies, such as revisions to BAC limits. SAT enrollment is often voluntary and, if successful, the impact of treatment is long-lasting. Even if SAT does reduce drunk driving, identifying this relationship from year-to-year changes in the number of SAT clinics may be difficult and perhaps inappropriate. We address these challenges with fixed effects where appropriate and with instrumental variables estimation.

Our results indicate that the numbers of total clinics and clinics offering outpatient treat-

[6] For an example of research that is able to more closely observe activity within communities following changes to SAT, see Hingson, Zakols, Heeren, Winter, Rosenbloom and DeJong (2005). The authors study five communities which received grants under the Robert Wood Johnson Foundation's "Fighting Back" program. These communities experienced declines in their ratios of alcohol-related to non-alcohol traffic fatalities. Due to the population sizes of these Fighting Back communities, the affected areas are not included in the data sample of the present paper.

ment are negatively and significantly related to the number of alcohol-related motor vehicle deaths. The relationship between treatment and non-alcohol fatalities is not significantly different from zero in our analysis. On average, increasing the number of clinics by one in all of our sample counties would reduce the number of alcohol-related motor vehicle deaths by 15% each year. Increasing the number of clinics that specifically offer outpatient treatment services would reduce the number of alcohol-related accidents by 26% per year. This reduction in alcohol-related deaths due to outpatient SAT amounts to 0.66 lives saved per county per year in our sample of smaller US counties. With 70% of the addicted population untreated, local policymakers have an opportunity to increase road safety by supporting increased substance abuse treatment.

2 Previous Research

The federal and state governments have utilized a variety of policies to reduce the incidence of fatal traffic accidents. Several of these policies, such as seatbelt laws, speed limit restrictions, and insurance regulations are not limited to alcohol-impaired drivers.[7] For the purposes of the present paper, however, we focus on efforts to reduce drug- and alcohol-related accidents.[8]

Policies to reduce alcohol consumption, especially before driving, comprise one important set of efforts to reduce alcohol-related accident fatalities. Some US counties have declared themselves to be "dry" and generally prohibit the sale of alcohol. Despite the strong nature of these restrictions, the effectiveness of this designation in reducing alcohol-related fatalities is unclear. Brown, Jewell and Richer (1996) find that dry counties in Texas have fewer fatal motor vehicle accidents each year than wet counties, but Baughman, Conlin, Dickert-Conlin and Pepper (2001) report that these differences across counties are more likely due to county-specific heterogeneity rather than the alcohol restrictions. Miron and Tetelbaum (2007) challenge previous beliefs that minimum legal drinking age laws had a significant impact on reducing traffic fatalities.

In addition to alcohol prohibitions, policy makers might also use prices to reduce alcohol

[7] See Cohen and Einav (2003) on the effects of mandatory seat belt usage laws on traffic fatalities. Cohen and Dehejia (2004) study no-fault insurance liability laws.

[8] See Adams and Cotti (2008) for an example of a policy – a smoking ban in bars – that was not intended to affect road safety but ultimately increased the incidence of impaired driving.

consumption. Several studies have found that beer taxes are associated with reductions in motor vehicle deaths.[9] The apparent success of these tax policies, however, may be specious. Once state fixed effects are included in the analysis, beer taxes appear to have a negligible effect on alcohol consumption.[10]

A second type of policy intervention is the strengthening of laws against impaired driving. Chaloupka, Saffer and Grossman (1993) compare the effectiveness of all major drunk-driving laws, and they find that punishments that include license revocation are the most successful in reducing motor vehicle deaths. By contrast, Benson, Rasmussen and Mast (1999) report that the only effective enforcement-oriented laws are those that increase the probability that a drunk driver will be pulled over by police.

In total, the empirical findings have been mixed on the effect of policy interventions on drunk driving accidents.[11] One lesson to draw from these results is that there exists an inherent difficulty in inferring a causal relationship when several layers of activity separate a policy intervention from its desired outcome (e.g. a beer tax's effect on consumption, which affects whether a potential driver is impaired, which then affects safety conditional on the decision to drive). A second lesson concerns the importance of potentially unobserved local characteristics that affect drinking behavior and road safety conditions. In our analysis below, we employ a variety of empirical strategies in order to establish that the relationship between SAT and driving deaths is robust.

3 Data

Our data are a panel of county-level variables for the years 1998, 2000, and 2002-2004. For a complete description of all variables and their sources, please see the data appendix. We limit our analysis to 1,926 counties that have populations between 5,000 and 80,000 in 1998 and are not in Metropolitan Statistical Areas (MSAs), resulting in 9,630 county-year observations. This sample covers over 60% of all US counties. There are two main reasons why we focus on this set of relatively small counties. First, we are focusing on situations in which both

[9] For example, see Chaloupka, Saffer and Grossman (1993), Ruhm (1995) and Cook (1991).

[10] See Dee (1999) and Mast, Benson and Rasmussen (1999).

[11] See Benson, Rasmussen and Mast (1999) for a discussion on how the lack of consistency in deterrence measures across different types of studies (microsurvey, state-level aggregates) leads to a wide range of results.

substance abuse treatment and vehicle travel are local. Data from counties in MSAs, which are characterized by frequent travel across county borders within a metropolitan area, would make it more difficult to uncover the true relationship between treatment and accidents. Second, we measure the supply of substance abuse treatment through the count of clinics. This approach to treatment supply is likely to be most informative when the number of clinics is small, as it is in non-metropolitan counties. A large percentage of our sample markets (68%) have either zero or one clinic, and in this situation moving between these numbers of clinics must change the amount of treatment taken by the addict population. By contrast, in a large city with dozens of clinics, adding a new clinic may be offset by small (and difficult to observe) reductions in incumbent clinics' capacities.

We select our population cutoffs of 5,000 and 80,000 by considering the counties in which small numbers of SAT clinics are most frequently observed, including the possibility that a market has no clinics. Of the counties with populations greater than 80,000, 99% have one or more clinics and 90% have at least two clinics. Only 15% of counties with fewer than 5,000 people have one or more clinics. In Section 4.3, in which we assess the robustness of our results, we investigate whether our main findings are sensitive to these population thresholds.

3.1 Fatal Accidents

Our data on traffic fatalities are from the Fatal Accident Reporting System (FARS), which is administered by the National Highway Traffic Safety Administration. During the years of our panel, approximately 37,000 fatal accidents occurred per year, resulting in 42,000 deaths.[12] Across the 3,140 counties in the US, this implies an average of about 12 fatal accidents per county per year. In our sample of smaller counties, there are 6.1 fatal accidents per county per year resulting in 6.6 deaths. In about a third of these accidents FARS indicates that a "drinking driver" was involved. For the purposes of this paper's analysis, we define an accident as *alcohol-related* if any of the variables in the FARS system indicate alcohol or drug involvement. An accident is alcohol-related if FARS reports: a BAC test result of at least 0.08, a positive drug test result, that a driver is charged with a drug or alcohol violation,

[12] Fatal traffic accidents may involve more than one fatality (e.g. the driver and passenger).

or that police identify a driver as being impaired by alcohol or drugs.[13] While the number of vehicular deaths per year increased slightly between 1998 and 2004, total alcohol-related fatalities have declined since 2002.

3.2 Substance Abuse Treatment

The primary explanatory variables of interest are the numbers of SAT clinics and outpatient-SAT clinics. In our sample, 86% of clinics offered outpatient services. Patients who receive outpatient treatment attend several hours of therapy per week that is scheduled around the patient's normal activities. Outpatient clinics usually offer a combination of individual and group counselling sessions. By contrast, inpatient treatment is residential, and patients who receive inpatient treatment are removed from their former surroundings. Inpatient treatment patients often travel substantial distances from their homes to the clinic.

Data on the location and characteristics of treatment facilities are from the National Survey of Substance Abuse Treatment Services (N-SSATS), an annual census of substance abuse treatment facilities conducted by the Substance Abuse and Mental Health Services Administration (SAMHSA). Due to temporary suspensions of the N-SSATS survey, data from 1999 and 2001 are not available.

In our sample the average number of clinics per county is 1.32, and about 70% of counties have at least one clinic. A small number of counties have a relatively large number of clinics, so we truncate at 8 the number of clinics per county.[14] This truncation affects fewer than 1% of the county-year observations in our sample.[15] In Table 1 we summarize SAT supply by year in our sample's counties. Much of the variation in treatment supply is cross-sectional, but around a quarter of counties experience a year-to-year change in the number of clinics. While this amount of variation is not negligible, a substantial fraction (50%) of the variation occurs in counties that begin or end a transition with three or more clinics.

[13] We search for any indication of alcohol and drug use because some of the relevant variables appear to be coded inconsistently. For example, some observations for which police record a "drinking driver" have BAC results that are zero or indicate that no test was given.

[14] We also truncate the number of clinics with outpatient services (separately) at 5, which affects about 1% of the observations in our sample.

[15] Our main empirical results are largely unaffected by this assumption. If we truncate at 9 clinics, the estimated effects fall slightly in our main results (in Table 6) but remain significant at the $p = 0.05$ level. If we reduce the truncation to 7 clinics, our coefficient magnitudes increase.

More importantly, the usefulness of this year-to-year variation in clinic counts is limited for us because of the voluntary and durable nature of SAT. Unlike a BAC limit or a beer tax that applies to all people immediately after it is enacted and disappears completely if it is removed, a change in SAT supply is unlikely to have an immediate effect on substance abuse in a market. For example, if the sole clinic in a market exits after several years of successful patient treatment, we would expect the clinic's market to continue having fewer problems with substance abuse and its consequences than a market that never had a clinic but shares all of the same observed and unobserved characteristics. This attribute of SAT prevents empirical models with county fixed effects from providing informative results in the analysis below.

3.3 County Demographics and Road Safety

We employ two additional sets of explanatory variables to describe variation in traffic fatalities across counties. First, we construct a set of control variables that describe a county's demographic characteristics. We do this to capture local economic conditions and tendencies for risky behavior, which can affect driving habits, drug and alcohol consumption, and the combination of illicit substances with driving. For each year in our data we observe a county's median age, median income, the unemployment rate, percentage below the poverty line, and percentages of blacks and Hispanics. Using data from the 2000 decennial census, we also observe the fraction of divorced females and the percentages of adults who have completed high school and college.

We use a second set of control variables to describe road safety conditions.[16] Due to data limitations and the level of government at which traffic laws are typically written, most of these variables are available at the state level rather than by county. We note whether a state has a standard seat belt enforcement law (i.e., drivers may be stopped for not wearing a seat belt without committing another offense), the state's level of vehicle miles traveled (VMT), traffic density, blood alcohol content (BAC) limits, and maximum speed limits. The maximum speed limit is at least 70 miles per hour in 53% of the states, and 40% of the states

[16] Our selection of road safety variables generally follows Cohen and Einav (2003) on the impact of seatbelt usage laws.

have a standard seat belt enforcement law.[17] The maximum BAC limit is 0.08 in 63% of the states over the years 1998-2004.[18] We also include the state excise tax rate on packaged beer per gallon. Other state laws on alcohol and driving, reviewed briefly in Section 2, varied only minimally over time in our panel, so the impacts of these laws are generally captured by state-level fixed effects, which we employ in our empirical analysis.

At the county level, we record the numbers of emergency medical personnel and hospitals to describe medical treatment quality conditional on an accident. These variables can also proxy for the county's overall disposition toward medical treatment, which may be correlated with local attitudes toward treating substance abuse disorders.

In Table 2 we provide summary statistics for motor vehicle fatalities and the control variables. For the county-year observations in this study, the average number of deaths per county is 6.7 and the average deaths per 10,000 residents is 3.07. The columns of Table 2 illustrate how county demographics and motor vehicle fatality rates vary with the number of clinics in the market. The numbers of total deaths and alcohol-related deaths both fall as the number of clinics increases, but non-alcohol vehicle deaths fall as well. This could be due to counties with larger and denser populations being able to support more clinics as well as reducing the average number of miles driven. Clinics are more common in counties with relatively high education attainment, income levels, and divorce rates.

3.4 Instruments

We are concerned that unobservable local characteristics may be correlated with both the number of SAT clinics and the number of traffic fatalities. As we argued in the Introduction, SAT supply could be negatively or positively correlated with the unobservables that affect motor vehicle deaths. To address this complication, in our preferred specifications below we employ instrumental variables (IV) estimators of SAT clinics' effects on motor vehicle deaths. In considering possible instruments to use within our analysis, we focus on factors which can shift the number of SAT clinics in a market without being related to local (unobservable) attitudes and activities that affect both treatment supply and driving behavior.

[17] During our sample period, one state changed its maximum speed limit to 70 mph from 65 mph. Seven states instituted a standard seat belt enforcement law during 1998-2004.

[18] During this period, thirty five states reduced their BAC limits to 0.08.

We use a county's number of practicing psychiatrists as an instrument for the county's SAT supply.[19] SAT clinics use psychiatrists to provide services, so an increase in the number of psychiatrists reduces the cost of operating a clinic. We assume, however, that the supply of psychiatrists is uncorrelated with the unobserved aspects of the local culture that contribute jointly to substance abuse, its treatment, and dangerous driving, after controlling for the observable measures of personal and economic stress that are captured in our demographic variables. A local population of psychiatrists cannot depend on SAT clinics alone for employment, as only 13% of clinics have a full-time physician on staff, so psychiatrists must be drawn into markets by more general mental health needs.[20]

4 Empirical Analysis

The probability of an alcohol-related fatal motor vehicle accident is affected by several stages of choices. First, an agent decides whether to consume alcohol or illicit drugs. Second, the agent decides whether to operate their vehicle. Third, conditional on driving, the agent makes choices while driving (e.g., at what speed to travel), while law enforcement officials decide how vigorously to patrol for impaired drivers. While policy interventions may occur at any of these stages, we focus primarily on the demand decisions in the first stage. We view SAT programs as a method to reduce demand for alcohol and drugs among agents whose consumption of these products may be excessive or lead to poor choices. It is also possible that while in SAT a consumer improves his ability to resist driving if he does ingest drugs or alcohol.

Our general empirical approach is to regress measures of motor vehicle deaths on measures of substance abuse treatment availability, controlling for local travel conditions and demographic characteristics. In these regressions we transform the total count of vehicle deaths into a measure of the number of deaths per 10,000 county residents. We refer to this

[19] We also investigated using state-level variation in mandated benefits under mental health parity laws. See Buchmueller, Cooper, Jacobsen and Zuvekas (2007) for an overview of these benefits. Unfortunately, the variation in benefit mandate laws is insufficient to provide an effective instrument for SAT supply.

[20] SAMHSA reports that in addition to the 13% of facilities that hire a full-time physician, 21% of facilities utilize at least one part-time physician and 37% of facilities have a contract physician on staff (Alcohol and Drug Services Study, 2003). In conversations with professionals in the field, we have confirmed that physicians involved in SAT are generally psychiatrists.

measure as the *rate* of motor vehicle deaths.[21]

Let $Clinics_{it}$ represent the total number of SAT clinics in county i during year t. $Deaths_{it}$ is the motor vehicle death rate in i during t. The vector D_{it} contains the demographic characteristics of the county plus a dummy variable for each year to capture national trends in SAT and road safety. The vector R_{it} includes information on state- and county-level road usage, road safety, and driving laws. The unobservable characteristics of county i during t are captured by the error term ε_{it}. Our empirical approach is to estimate models of the form:

$$Deaths_{it} = \alpha + \beta Clinics_{it} + D_{it}\delta + R_{it}\rho + \varepsilon_{it}. \tag{1}$$

In some models below we replace the variable $Deaths_{it}$ with a similarly-constructed measure of the alcohol-related death rate in county i during year t. In addition, we perform some of our analysis with the number of outpatient clinics in county i during t instead of $Clinics_{it}$.

Throughout the analysis below, a central concern is the nature and content of the error term ε. As we argued above, ε may be correlated with $Clinics$. We take several approaches to estimating the empirical model in order to recover estimates of β that are robust to a variety of concerns about ε. Throughout the analysis we allow ε_{it} to contain a state-level fixed effect to control for unobserved characteristics of states that may drive correlation between SAT and motor vehicle safety. That is, we specify $\varepsilon_{it} = \mu_s + \nu_{it}$, with μ as the fixed effect. In addition, we cluster standard errors at the state level to capture heterogeneous effects of $Clinics$ on $Deaths$ at the state and county levels.

4.1 Estimation with Exogenous SAT

We begin by estimating (1) under the assumption that ν_{it} is uncorrelated with $Clinics$ and the remaining explanatory variables. We consider the effect of $Clinics$ on all motor vehicle deaths, alcohol-related deaths, and non-alcohol deaths. Our results are in Table 3. In the "All deaths" specification, the estimated coefficients δ and ρ contain some expected results and some surprises. *Deaths* falls with the unemployment rate, which could reflect reduced travel, and it also falls with educational attainment, which could reflect the opportunity

[21] While it may be preferable to calculate the number of deaths per mile traveled, the necessary data are not available at the county level.

cost of a traffic injury. Within-panel variation in state-level safety regulations, such as seat belt requirements, have no significant impact on the death rate. In specifying the dependent variable as a rate, we interpret the population variables as measures of congestion or opportunities to travel within a county.

The relationship between SAT clinics and deaths appears weak. In each specification we find a small negative relationship between the number of clinics and the death rate, and in all three cases the estimate is insignificantly different from zero. For all deaths and alcohol-related deaths, however, we note that the *Clinics* coefficients have t-statistics with magnitudes over 1.5. We obtain similar results if we replace *Clinics* with the number of outpatient facilities in a county.

We also present results from estimating (1) with the error term specified as $\varepsilon_{it} = \mu_c + \nu_{it}$, with μ as a county-level fixed effect. These results are in Table 4, and the SAT-related point estimates are similar to those in Table 3. There appears to be a small, negative relationship between motor vehicle deaths and the number of clinics, but the coefficients are not statistically significant and the relevant t-statistics are less than 1. This is not surprising, given that the durable and voluntary nature of SAT may imply that models utilizing county fixed effects are poorly suited to this analysis.

While our initial models control for some unobserved local differences in substance abuse patterns and traffic fatalities, it is likely that correlation between *Clinics* and ν remains.[22] Our intuition on the relationship between unobserved county characteristics and *Clinics* suggests that the correlation is most likely to be positive. Counties with more pervasive (unobserved) alcohol problems will have both more SAT clinics and more auto deaths. This implies that the estimates in Table 3 are positively biased, and addressing the problematic correlation could increase the magnitude of our SAT-related coefficients.

4.2 Instrumental Variables Estimation

Our preferred approach to the empirical problem involves instrumental variables estimation of SAT clinics' effects on fatalities. We begin this analysis by estimating the first-stage

[22] Previous research on motor vehicle fatalities has illustrated the potential for unobserved market characteristics to bias the results of OLS estimates. For example, see Cohen and Einav (2003); Baughman, Conlin, Dickert-Conlin and Pepper (2001); and Mast, Benson and Rasmussen (1999).

relationship between the number of psychiatrists and the numbers of clinics and outpatient clinics. These results, which are presented in Table 5, show a positive and significant impact of psychiatrists on SAT.

Table 6 contains our IV estimates of the effect of SAT clinics on auto fatalities. We find that the alcohol-related death rate falls significantly with the addition of a SAT clinic (Models 1-3). When we focus on outpatient clinics (Models 4-6), which are more likely to treat the local population, the reduction in the alcohol-related death rate is larger in magnitude and again significantly different from zero. In interpreting these results relative to those in Table 3, we conclude that some counties are unobservably "dangerous," and the relatively high level of substance abuse in these counties attracts more clinics while also causing more vehicle deaths.

To confirm that we are recovering a treatment relationship between SAT clinics and driving under the influence, we estimate the impact of *Clinics* and outpatient clinics on the non-alcohol death rate, and we find no significant reduction in this rate with an increase in the number of clinics of either type. The negative coefficient on *Clinics* in the model of non-alcohol deaths may be due to data difficulties in classifying alcohol-related deaths appropriately.

We can use the coefficient estimates to make predictions regarding the number of lives that would be saved by increasing or introducing substance abuse treatment facilities.[23] We find that an additional clinic in the average county of $24,000$ people reduces alcohol-related deaths by 0.37 (15%). Specifically increasing the number of clinics offering outpatient services leads to a decrease in alcohol-related deaths by 0.66 (26%).

4.3 Robustness

To assess the robustness of our results we now consider several variations on the models discussed in Section 4.2. We first generalize the error structure to include a separate fixed effect for every state-year pair, i.e. $\varepsilon_{it} = \mu_{st} + \nu_{it}$. This captures all state-level trends and

[23] To calculate the reduction in deaths from increasing the number of facilities, we begin by predicting the number of motor vehicle deaths per 10,000 residents using the IV coefficient estimates. Next we increase the number of clinics in each county by one and predict the motor vehicle deaths rate given the new number of clinics. We take the difference between the two predicted rates, multiply by the population, and then report the average as the number of lives saved.

policy changes that may have affected SAT services and driving behavior. Our results, which are reported in Table 7, are very similar to those in Table 6 with state fixed effects. An increase in the number of clinics or the number of outpatient clinics results in a significant reduction in alcohol-related deaths, but no significant change in overall or non-alcohol deaths.

We also consider a potential concern that *Clinics* and (separately) psychiatrists are positively correlated with the quality of medical care in a market. While we already include controls for a county's numbers of hospitals and emergency medical personnel, other differences across counties may remain. If this is the case, then lower death rates associated with more SAT may be due to the medical care accident victims receive, and not a reduction in impaired drivers on the road. We investigate this possibility by focusing on fatalities in which a victim is declared dead at the scene of an accident, which is the case for 57% of all accident deaths in our sample. We re-estimate the models of Table 6 with our original error structure ($\varepsilon_{it} = \mu_s + \nu_{it}$) and with psychiatrists as an instrument, and we report results on Table 8. All estimates in Table 8 are closer to zero than those in Table 6, with the treatment coefficients for the models of alcohol-related deaths 57% smaller, matching exactly the proportion of deaths that occurred at the scene of an accident. The impact of SAT clinics on these alcohol-related deaths is significantly different from zero at the $p = 0.10$ level.

Next, we consider the impact of unobserved local travel conditions on death rates. It may be the case that counties with unusually dangerous roads have high vehicular death rates of all sorts, including alcohol-related deaths. For example, a county could have road construction, weather fluctuations, or economic conditions that are difficult to observe but have a substantial effect on road safety. We account for this by including a county's non-alcohol death rate as an additional control variable in our models of alcohol-related deaths. Our results are presented in Table 9, in which we show that the main results of Table 6 are largely unchanged. In addition, we find a strong positive correlation between alcohol and non-alcohol death rates.

Finally, we consider the impact of altering the population thresholds of 5,000 and 80,000 which we use to define the relevant markets for our sample. In Table 10 we display how our main results on outpatient clinics are affected by changing the population threshold. The relevant results from Table 6 are repeated as the "Base Models" for convenience. Models

1-3 show that when the lower population threshold is removed, the impact of adding another outpatient clinic to the market becomes larger in magnitude. This is likely because an additional clinic in these markets is usually the first or second outpatient clinic that a county receives, and previously there would have been little or no treatment opportunities for the worst-off patients. In Models 4-6 we reduce the upper population limit to 70,000 while retaining the lower limit of 5,000. There are few notable differences between these results and those in the base models, in part because the sample size fell by less than 2%. The change in sample size is slightly smaller when we increase the population threshold to 90,000, but we see in Models 7-9 that this change eliminates the statistical significance of our main result by reducing the magnitudes of the coefficients. This is probably due to the nature of additional clinics in the markets with populations between 80,000 and 90,000. In contrast to the markets on which we focus in our main analysis, counties in this population range have an average of 4.75 clinics, so adding another clinic to these markets may have little marginal value, thus reducing the magnitude of the coefficients. This reinforces our conjecture that increasing the clinic count is most closely related to increasing effective SAT in markets with very few clinics. In larger markets, increasing treatment may be equally effective in reducing deaths but it is more difficult to detect through changes in the number of clinics.

5 Conclusion

Drug and alcohol consumption leads to motor vehicle fatalities. One policy for reducing drug and alcohol consumption is increasing the provision of local substance abuse treatment. In this paper we find that a policy of increased treatment for substance abuse problems results in a statistically significant decrease in alcohol-related motor vehicle deaths.

Uncovering this relationship is challenging because of the local unobservables that are likely correlated with both SAT and vehicle deaths, as well as the voluntary and long-lasting nature of SAT. We address these challenges by including state-level fixed effects and using instrumental variables estimation. We control for local demographic and driving conditions, and we use the number of practicing psychiatrists as an instrument. The results are robust to a variety of approaches to the data, and we show a consistent and strong relationship between the number of treatment facilities and the alcohol-related motor vehicle death rate.

Our results imply that increasing the number of outpatient treatment facilities in the sample counties reduces the number of alcohol-related deaths from 2.52 by 0.66 per year. In the 1,926 US counties we study, this implies 1,271 fewer deaths in alcohol-related traffic accidents per year.

This estimated reduction in deaths is large because SAT works by reducing a population of disproportionately dangerous drivers. Levitt and Porter (2001) use data on accidents involving two drunk drivers to estimate that impaired drivers are 15 times more likely to cause a fatal accident than a sober driver. The FARS data offers further evidence of these dangers, as about 10% of alcohol-related fatal accidents involve drivers with a DUI conviction in the last three years while only 0.6% of drivers receive a DUI each year (National Survey on Drug Use and Health, 2003). Considering the population of individuals with drug and alcohol dependence problems that are currently untreated and the potential for these individuals to become dangerous drivers, policymakers have an opportunity to increase road safety while also enhancing local health by supporting increased substance abuse treatment.

A Data Appendix

1. Substance Abuse Treatment (SAT). County level data on SAT are from the National Survey on Substance Abuse Treatment Services (N-SSATS).

   - Clinics – number of SAT clinics
   - Outpatient Clinics –number of SAT clinics offering outpatient services

2. Motor Vehicle Deaths. County level data on deaths are from the Fatalities Analysis Reporting System (FARS).

   - Motor Vehicle Deaths – the number of traffic fatalities of drivers and passengers
   - Alcohol-Related Motor Vehicle Deaths – the number of traffic fatalities where alcohol or drugs may have been a factor

3. Instruments. County level data on practicing psychiatrists are from the Area Resource File (ARF).

   - Number of Psychiatrists

4. Control Variables.

   (a) County level demographic data are from the US Census and the ARF.

   - Population – county population, divided by 10,000 in regression analysis
   - % Black
   - % Hispanic
   - Median Age – in years
   - Median Income – in dollars, divided by 10,000 in regression analysis
   - % Poverty
   - % Unemployment
   - % College Graduate – percentage of adults with a college degree (2000 Decennial Census)

- % HS Graduate – percentage of adults with a high school degree (2000 Decennial Census)
- % Females Divorced – percentage of women divorced (2000 Decennial Census)
- Emergency Personnel – number of emergency medical personnel
- Hospitals – number of hospitals

(b) State level traffic variables are obtained from the publication "Highway Statistics" (U.S. Department of Transportation, Federal Highway Administration).

- Traffic Density Rural – registered vehicles per mile of rural roads
- Traffic Density Urban – registered vehicles per mile of urban roads
- VMT Rural – vehicle miles traveled on rural roads, divided by 100,000
- VMT Urban – vehicle miles traveled on urban roads, divided by 100,000

(c) State level traffic and highway laws are from the Insurance Institute for Highway Safety.

- Speed Limit 65 mph – a dummy variable equal to 1 when 65 mph is the state's top speed limit
- Speed Limit 70 mph – a dummy variable equal to 1 when 70 mph is the state's top speed limit
- Standard Seat Belt Enforcement – a dummy variable equal to 1 when the state has a standard-enforcement mandatory seat belt law

(d) State DUI laws are from the National Conference of State Legislatures.

- BAC of 0.08 – a dummy variable equal to 1 when a state has a blood alcohol content of 0.08 to qualify as DUI

(e) County level crime variables are from the Department of Justice.

- Violent Crimes Reported – a sum of the violent crimes (homicide, rape, robbery, aggravated assault) reported per capita
- Property Crimes Reported – a sum of the property crimes (larceny, burglary, motor vehicle theft) reported per capita

(f) State level alcohol taxes are from the annual publication "Brewers Almanac 2007."

- Beer Tax Rate – Annual excise rate on packaged beer per gallon

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