DOES SOCIAL CAPITAL PROMOTE SAFETY ON THE ROADS?

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I present evidence that social capital reduces traffic accidents and related death and injury, using data from a ten-year panel of 48 U.S. states. The econometric challenge is to distinguish the causal effects of social capital from bias resulting from its correlation with unobservable characteristics by state that influence road risks. I accomplish this by employing snow depth as an instrument, and by restricting attention to summertime accidents. My results show that social capital has a statistically significant and sizable negative effect on crashes, traffic fatalities, serious traffic injuries, and pedestrian fatalities that holds up across a range of specifications.

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I. INTRODUCTION

Social capital has generated substantial academic interest over the past two decades in the wake of two influential books by Robert D. Putnam, *Making Democracy Work* (1993) and *Bowling Alone* (2000). A large number of recent studies suggest that interpersonal trust and civic engagement have positive economic impacts (e.g., Narayan and Pritchett 1999, Knack 2001, Zak and Knack 2001, Grootaert et al. 2002, Karlan et al. 2009). Recent work also indicates that social capital, measured variously, has beneficial impacts on health and well-being.[1] The research attention has, however, brought with it a measure of controversy. While there is much evidence of association between social capital and outcomes relevant to economics, causal links have been hard to establish conclusively (Helliwell 2001). The lack of evidence of causation flowing from social capital to putative outcomes has been one of the central critiques of this literature (see, e.g., Sobel 2002).

This paper examines how social capital relates to highway safety. It uses an aggregate measure of generalized interpersonal trust to explain variations in the level of traffic fatalities and three other measures of highway safety across a panel of U.S. states over the years 1997-2006. The focal point of my approach is an innovative identification strategy that solves the problem of establishing causation.

The main difficulty with estimating the effect of social capital on highway safety at an aggregate level is that selection on unobserved characteristics of the population may introduce spurious effects. For example, if less conscientious individuals who both eschew civic engagement and drive more recklessly tend to sort disproportionately across states, one might observe higher rates of fatal accident and other highway risk measures in states with lower levels of social capital. This, of course, would prove nothing about the effects of social capital per se.

The paper addresses this problem by exploiting variation in winter snow depth across states as an exogenous source of variation to social capital formation. Snow depth offers a relevant instrument because a snowy climate impacts the long-term movement patterns of individuals. These in turn are relevant to the extent to which individuals form strong ties with each other. But for this instrument to be valid, it must also be orthogonal to unobservable determinants of highway risks. As snow accumulation likely contributes directly to the incidence of accidents during the winter, I restrict the dependent variable to safety-related incidents occurring during the summer.[2] Conceptually, while variation in snow depth plausibly explains variations in social capital from state to state, it does not directly affect the rate of accidents in the summer (non-snow) months of the year.[3] Thus I am able to investigate how relative differences in social capital – for which variation is induced through exogenous snow depth variation – influence non-snow-related rates of traffic incidents.

I find that social capital has a significant negative impact on the incidence of crashes, injuries and deaths on the roads. For example, a one-standard-deviation increase in my main social capital variable – the average individual agreement level with the statement, "Most people are honest" – results in a decline in state crashes of between 9 and 18%, a decline in traffic fatalities of between 11 and 19%, a decline in serious injuries of between 11 and 22%, and a decline in pedestrian fatalities of between 20 and 39%.

A number of previous studies have used ordinary least squares or fixed effects regression to estimate the economic effects of social capital (e.g., Helliwell 1996, 2007; Narayan and Pritchett 1999; Maluccio et al. 2000; Grootaert et al. 2002; Yamamura 2008). While some studies have attempted to account for selection bias by employing instrumental variables techniques (e.g., Knack and Keefer 1997, Narayan and Pritchett 1999, Maluccio et al. 2000, Zak and Knack 2001, Easterly et al. 2006), the instruments have largely consisted of other sociopolitical variables. Given the nature of relationships among social science variables, questions remain about the endogenity of such instruments and whether they may be reasonably perceived as meeting the exclusion criteria. With its “natural” (i.e., climatic) experimental design, the present study offers an important innovation in conclusively demonstrating the effects of social capital.[4]

An important motivation for this study is that traffic fatalities pose a serious public health problem worldwide. Over one million deaths are attributed each year to automobile accidents (Bishai et al., 2006). If current trends are not reversed, traffic injuries are projected to grow from the ninth leading cause of disability-adjusted life years lost in 1990 to the third by 2020 (Murray and Lopez, 1996). In the United States, a trend of declining traffic deaths during the 1970s and 1980s, attributable to the use of seat belts and adoption of safety equipment such as antilock brakes, has yielded to stagnation since the 1990s; the toll in the U.S. remains near 43,000 deaths annually (White, 2004). Traffic fatalities remain a major cause of death at all ages and the leading cause for persons under the age of 44 (Heron et al., 2009).[5]

The rest of the paper is structured as follows. Section II considers conceptually why social capital should affect highway safety. Section III lays out my empirical strategy. Section IV describes the data used in the study. Section V evaluates the instrumental variables mechanism. Section VI presents results and robustness checks, and Section VII discusses public policy implications.

II. WHY WOULD SOCIAL CAPITAL AFFECT HIGHWAY SAFETY?

What *is* social capital? Most definitions relate to the idea that social connections between people hold value, in a similar manner to other forms of capital (Sobel 2002). I adopt Lynch and Kaplan's (1997, 307) definition of social capital as a "stock of investments, resources and networks that produce social cohesion, trust, and a willingness to engage in community activities." Thus, social capital comprises a *structural* component – social networks, connections, and resources – and a *cognitive* component – a set of perceptions and attitudes (Harpham et al. 2004). This dichotomy allows one to speak of benefits that arise directly from investment in interpersonal connectedness and other communal resources, and also of benefits that arise from the attitudes (e.g., trust) that those resources create within a community.

The literature breaks down investment in social capital into a range of activities. Putnam (2000, 290), for example, refers to group membership, attendance at public meetings, service in local organizations, attendance at club meetings, volunteer work, entertaining at home, and electoral turnout. It is not uncommon in the literature for social capital to be measured based on participation rates and intensity or frequency measures for activities such as these.

Trust and the desire to be trustworthy, part of the cognitive (or attitude-based) component of social capital, are associated with important, measurable outcomes in a societal context. According to Coleman (1990, Chapter 5), trust that other people will abide by norms of reciprocity, fair-dealing, and courtesy motivates people themselves to behave in a trustworthy manner. This trustworthiness, in turn, facilitates a range of otherwise intractable economic and social activities, with non-trivial implications. For example, it reduces the costs of many economic transactions, allows implicit contracts to replace explicit contracts, and facilitates credit. In achieving these things, trust plays a key role in promoting economic growth (Knack and Keefer 1997; Knack 2001).

Like many economic activities, driving on public roads is inherently a coordinative activity among individuals. It is plausible that trust and norms of trustworthiness would affect the nature of interactions on the roads in ways that have a significant impact on highway safety.

Anecdotally one witnesses a range of driving behaviors that are suggestive of a range of underlying attitudes. Drivers may behave courteously toward one another, yielding to merging cars, and signaling or waving to assist other motorists even when their own safety is not dependent upon these actions. Such situations are perceptibly characterized by trust and cooperation: people act as if there were a social contract, a set of rules that all obey and that everyone trusts others will obey. In other situations, one may see motorists honking or shouting at one another, rushing to be the first through an intersection or merge point, and so forth. These situations may seem to be governed not by a social contract of trust and trustworthiness, but by "the law of the jungle" (Grjebine 2000). While, unquestionably, it is more pleasant to be on the road when people are acting in the former way rather than the latter, one can see how it might also be safer. Aggressive, or simply non-cooperative, driving could plausibly lead to more frequent and serious accidents.

Levels of trust and trustworthiness might also affect highway safety through vehicle choice. Sport-utility vehicles (SUVs) are typically longer, wider, taller, and heavier than cars. Their size makes them desirable to consumers, in part because consumers equate size with occupant protection in the event of a crash (Gladwell 2004, White 2004). The allure of SUVs may also work on a more visceral level, with some consumers choosing them as a reaction to nonspecific fears and insecurities with respect to other people, to wit, as "armored cars for the battlefield" (Bradsher 2002, p. 97). Recent studies suggest the perceived benefits come, however, at a cost of increased risks of death and injury to the occupants of other cars; and that, in fact, *overall* fatalities and injuries are increased by the substitution of light trucks for cars on the road (Gayer 2004, White 2004). To the extent that this is understood by drivers, the decision to drive an SUV may thought of as based on a cynical calculus: if I cannot trust other motorists to keep me safe, then I will protect myself, even if I do so at the expense of other motorists.

Might there be a pattern to the variations in attitudes and associated driving and vehicle choice behaviors? Helliwell (2003, 12) points to differences across geographies in the "extent to which people might feel that traffic and other norms are reliably accepted by other drivers."[6] A testable hypothesis, then, is that measurable differences in trust from one place to another lead to differences in behaviors, with measurable safety-related consequences.

In addition to making the roads safer by fostering trust, investments in social capital plausibly contribute to highway safety in other ways. Investments by the citizenry in civic and political engagement arguably promote enactment and enforcement of highway safety laws, leading to lower rates of traffic death. This proposition is consistent with the existing literature. Knack and Keefer (1997) suggest that knowledge of politics by a large number of citizens can provide a safeguard against government corruption and ensure more effective governance. Putnam (1993) showed that the regional governments in northern and central Italy, where the populace were more active in their community and in the political process, provided public services more effectively than the less civic-minded and politically-engaged south. Meanwhile, evidence from empirical studies connects aggregate highway safety outcomes to functionality of the political and legal environment. In an international study, Anbarci et al. (2006) showed that lower levels of political corruption correlate with lower rates of traffic fatality. In several studies at the U.S. state-level, alcohol taxes, speed limits, and various other laws have been linked to lower rates of traffic fatality (see, e.g., Loeb 1987, Keeler 1994, and Ruhm 1996).

III. EMPIRICAL STRATEGY

Traffic incidents – crashes, serious injuries, and fatalities – are count variables close to zero: the probability that a given member of the population will be involved in one during a given period is low, and there are a finite number of such incidents. As such, the determination of traffic incidents is best modeled as a Poisson process; one may appropriately represent this process by the following specification (Keeler 1994):

$$y_{it} = \exp\left(X_{it}'\beta + \varepsilon_{it}\right) \tag{1}$$

where y_{it} consists of the count of the relevant incidents occurring in state *i* and year *t*, X_{it}' is a corresponding vector of observed characteristics, and ε_{it} consists of unobservable determinants of incidents. A linear estimation model for traffic incidents is derived from (1) by taking natural logs of both sides.

My particular specification elaborates on the log version of (1) to represent the formation of social capital and its role in traffic incidents as follows:

$$\begin{aligned} \log\left(y_{it}\right) &= \alpha S_{it} + \sum_j \beta_j X_{ijt} + \varepsilon_{it} \\ S_{it} &= \sum_j \gamma_j X_{ijt} + \xi_{it} \end{aligned} \tag{2}$$

Here S_{it} represents a measure of social capital, the X_{ijt} are the remaining observed characteristics, and ξ_{it} are unobservable determinants of social capital.

Consistent estimation of (2) requires that $E\left(\varepsilon_{it}, \xi_{it}\right) = 0$. This is likely to be violated. States with more reckless drivers might well have a different rate of selection into activities of social or civic engagement. In particular, personal tendencies toward courteous driving and civic responsibility are probably correlated. Hence, unobservable differences in the distribution of individuals' characteristics across states influence both the level of social capital and traffic incidents. This biases the estimation of coefficients in the incidents equation in (2).

One may eliminate the bias by employing an instrument Z_{it} that is correlated with social capital but otherwise independent of traffic incidents. An appropriate instrument would offer a source of exogenous variation in social capital approximating the random assignment arising from an experimental process. I propose snow depth. In Section V, I will provide evidence supporting the conceptual basis for using snow depth as an instrument – that snow depth affects the long-term movement patterns of individuals, which in turn determines social capital formation. In Section VI, the results of my first-stage estimation (i.e., of the second equation in (2)) will be set forth as evidence that snow depth is correlated with endogenous social capital.

To be a consistent instrument, snow depth must meet an additional condition, that of being independent of the number of crashes, serious injuries, and traffic fatalities. This condition is not likely to be met, because snow tends to make roads less safe for driving. Following Gayer (2004), who also employs snow depth as an instrument in a highway safety regression, I address this problem by restricting my traffic incident measures to crashes, injuries, and fatalities that occur during the summer months (June, July, and August). That is, in (2), I replace y_{it} with $\tilde{y}_{it}$, which counts the relevant traffic incidents occurring in state *i* in June, July, or August of year *t*. The estimated version of the two-stage system becomes

$$\begin{aligned} \log\left(\tilde{y}_{it}\right) &= \alpha \hat{S}_{it} + \sum_j \beta_j X_{ijt} + \tilde{\varepsilon}_{it} \\ S_{it} &= \delta Z_{it} + \sum_j \gamma_j X_{ijt} + \xi_{it} \end{aligned} \tag{3}$$

where $\tilde{\varepsilon}_{it}$ represents the unobservable determinants of incidents occurring in the summer.

Consistent with Gayer's (2004) analysis, whereas $E\left(Z,\varepsilon_{it}\left|X_{it}\right.\right)\neq 0$, strict identification of the estimated equation system depends instead on $E\left(Z,\tilde{\varepsilon}_{it}\left|X_{it}\right.\right)=0$. But while the analogous condition is met for Gayer's model, this condition is not met for the present model: snow depth likely affects the rate of traffic incidents in the summer positively through increased year-round selection into SUVs and other light trucks, something which is not accounted for in the estimated equation. However, as shall be observed in Section VI, the violation of the exclusion restriction in the present model runs counter to snow depth's effect on traffic incidents through social capital: snow depth instrumenting for social capital has a *negative* influence on summer traffic incidents. Thus the effects of vehicle selection actually reinforce identification of the causal effect of social capital.

IV. DATA

I have compiled count data by state by year for the 48 contiguous United States on the incidence of four types of traffic events: total accidents, total fatalities in accidents, pedestrian fatalities, and serious injuries (defined as disabling or incapacitating, and incorporating fatalities as a subset). All counts relate to the months of June, July, and August only. All traffic event data came from the Fatality Analysis Reporting System of the National Highway Traffic Safety Administration and cover the ten-year period 1997 through 2006.

My sample includes 14 state-year observations in which summer pedestrian fatalities take a value of zero. To avoid dropping observations when logs are taken in order to estimate (3), I adjust the zero-value observations in the data to "1." This is a trivial adjustment in terms of its real significance to the variable; nevertheless, I perform a robustness check on the effects of the adjustment in Section VI.

I measure social capital for the main regressions by the trusting attitudes it creates. Specifically, I use a measure of generalized trust derived from responses to a question in the DDB Life Style Data, which asks respondents whether "most people are honest."[7] Individual responses were reported on a six-level agree/disagree scale, with "6" representing the greatest level of agreement with the statement. I averaged responses within each state-year using sample weights to obtain the variable for use in the study. Because the variable was characterized by low survey response rates for some smaller states, I used a two-part strategy to ensure a reliable set of state-year averages. First, for five low-count states, I replaced the state-year averages with averages from higher-count adjacent states. Second, I took a three-year moving average of all state-year observations, weighting by the response count for each state in each year.

Prior studies have made extensive use of trust measures to represent social capital. (For example, see Kawachi et al. 2004 regarding the use of trust in health studies.) Survey-response measures of generalized trust have been discussed at length in the literature (e.g., Knack and Keefer 1997, Uslaner 2002, Soroka et al. 2006), and there is reasonably good evidence supporting their validity and reliability. Knack and Keefer (1997), for example, refer to evidence that the trust measure from the World Values Survey (WVS) tracks closely with the results of a trust experiment involving recovery of a "lost" wallet, conducted in 1996 in 20 cities selected from 14 western European countries. While the measure I employ asks whether most people are honest rather than whether "most people can be trusted," which is the wording most commonly used (e.g., in the WVS), Putnam (2000, 487) finds that responses to the two questions are very highly correlated. In Section VI, I examine the robustness of my results with respect to substituting a measure based on the more common trust question.[8]

My data for snow depth come from the "Surface Summary of the Day" produced by the National Climatic Data Center. This source offers surface condition data for every weather station in the United States. Following the methodology described by Gayer (2004, 111), I calculate two separate state-by-year instruments. The first consists of the average daily snow depth in inches across all weather stations for days in January, February, March, October, November, and December. The second consists of the average across weather stations of the maximum snow depth measures for each station for the entire year. While I will not present the data here in the interest of space, I can confirm that most of the sample variation in my snow depth measures occurs across states, rather than within states over time. Given this, it will be particularly important to affirm that snow depth is uncorrelated with unobservable state heterogeneity affecting summer traffic incidents. I address this issue in the second part of the next section.

Table 1 presents summary statistics for traffic incidents, social capital, and snow depth.

V. EVALUATING THE IV MECHANISM

My instrumental variables strategy presumes that snow depth influences the movement patterns of individuals, and that this affects the development of social capital. I check that this mechanism is indeed operative by examining the cross-sectional effect of snow depth on average commute time by state. I then consider whether instrumented commute time influences my measure of social capital across states.[9]

Data on commute time were obtained from the American Community Survey 2005-2007 three-year estimates, prepared by the U.S. Census Bureau. I employ two measures: the natural log of the percent of people by state with commute time under ten minutes, and the log percent of people with commute time under 15 minutes. With respect to commuting and social capital, it is not clear *a priori* which way snow should "cut." It is possible that the overriding effect of snow on movement patterns is to encumber people when they leave their homes during the winter. If so, then commute time could increase on average over the year, despite the absence of snow as an encumbrance during the other seasons. By both confining people to their homes during the winter, and requiring them to devote more time when they must leave their homes (e.g., to go to work), snow could thereby discourage civic engagement on average over the year, reducing social capital. Alternatively, snow might induce people to seek jobs substantially closer to home, such that a long-term time-saving effect dominates the winter encumbrance effect, reducing average commute time. If true, this would tend to *increase* social capital for two reasons. First, it would cause people to have more time on average for civic engagement. Second, the effect of snow on commute patterns per se would tend to intensify interaction among people within a smaller radius, creating stronger bonds and greater trust within that radius.[10]

Table 2 shows the results of both stages of the instrumental variables regressions. The four specifications represent different combinations of my commute time and snow depth measures. Indicator variables control for fixed effects based on assignment of states to the nine U.S. regions defined in the *Statistical Abstract of the United States* (U.S. Census Bureau, 2008). With respect to the first stage, the results show across the board that snow depth has a statistically significant positive relationship to the share of people with short commutes. The effects are large enough to have practical significance as well: for instance, a one-standard-deviation increase in the average daily snow depth variable is associated with an increase at the mean of more than an eighth in the share of people commuting less than ten minutes to work (from 16.9% to 19.2%).

These results suggest that when a state averages a greater depth of snow each winter, its residents are induced to work closer to home and, thus, to save time year-round and perhaps to focus their interpersonal interactions within a smaller radius. Does this result in higher levels of social capital? The second-stage results indicate that it does. I find a positive relationship between the share of people in short commutes and the average agreement level with "most people are honest." This effect is highly statistically significant across all four specifications.

Figure 1 displays visually the state-by-state relationship of the share of workers with short commutes to my social capital measure. With the exception of three outliers – northern plains states with short commutes but not so much social capital – a positive relationship between social capital and short commutes emerges clearly from the plot. Overall, the results affirm my proposition that interstate differences in winter snow depth influence average year-round movement patterns, and that these in turn have a significant impact on social capital.

VI. RESULTS

<u>OLS</u>

Having checked the validity of my IV mechanism, I now turn to the main estimation results. I begin with estimates of the determinants of traffic fatalities using ordinary least squares. I employ a version of (3) that incorporates control variables in log form, following previous work on the determinants of traffic incidents by Kopits and Cropper (2005) and Bishai et al. (2006). Each estimated specification controls for real gross state product per capita, vehicle miles traveled per capita, state population, unpaved roads as a percent of local road mileage, gas stations per 1,000 population, population per mile of road (in thousands), percent of population age 65 and over, and the maximum state speed limit. The social capital variable (agreement with "most people are honest") is included with the other covariates. I estimate four specifications in all, based on the addition of different combinations of a general time trend, year indicators, and a state-specific linear time-trend. Inclusion of these controls should help reduce selection bias, as they will pick up the effects of mean shifts in any unobservable determinants across years, as well as variations in unobservables that occur linearly over time or over time within states.

The results, displayed in Table 3, suggest that social capital reduces traffic fatalities. The coefficient estimates in all specifications are statistically significant at the 1% level. Moreover, the R-squared values for each regression indicate an excellent fit for the model. As discussed, however, the coefficient estimates from OLS may be biased as a consequence of selection on unobservable characteristics. I therefore proceed with instrumental variables estimation.

Instrumental Variables

I estimate the same four specifications using a two-stage instrumental variables procedure as discussed in Section IV. Table 4 presents the results. The top panel of the table displays both first- and second-stage results for the four specifications employing as the instrument average daily snow depth for the months January, February, March, October, November and December. The bottom panel shows estimation results for the same specifications, except with maximum snow depth for the year, averaged across weather stations, as the instrument.

The first-stage results indicate consistently strong explanatory power for the instrumental variable. Across all eight specifications, the F-statistic for significance of the instrument is greater than ten; this suggests a robust fit in the first-stage regression, such that inference based on the two-stage least squares estimator is reliable (Stock, Wright and Yogo 2002). The partial R-squared values indicate a strong correlation between my social capital variable and the snow depth instruments for the most part (see Bound, Jaeger and Baker 1995). The coefficients on the snow depth instrument are positive and highly statistically significant in the first-stage results across all specifications. Increases in snow depth are thus associated with higher levels of social capital, consistent with the findings of my commute-time analysis.

Meanwhile, the results at the second stage indicate a robust negative relationship between social capital and traffic fatalities. While using stricter fixed-effect controls diminishes the size of the effect noticeably, nevertheless the outcomes consistently show a highly statistically and practically significant impact of social capital on highway safety. The coefficient in model #4 indicates that a one-standard-deviation increase in the average level of agreement with the statement, "Most people are honest" – an increase of about 5%, or about the difference in average agreement levels between Alabama and Arkansas – results in a decline in traffic fatalities by about 11%. The effect indicated by the coefficient in model #5 is more than two-thirds larger, and would imply a decline in fatalities by about 19%.

Similar effects are observed for other types of traffic incidents. Table 5 shows the results of IV estimation on the eight models presented in Table 4, but for four different incident measures: summer traffic fatalities (presented previously in Table 4), summer crashes, summer serious injuries, and summer pedestrian fatalities. Only the second-stage results are displayed.

Across all incident measures and almost all specifications, I find that social capital has a statistically significant negative effect on traffic incidents. The exception is pedestrian fatalities, on which social capital exhibits a weakly significant or insignificant effect in specifications incorporating a state-specific linear time trend. But the results are otherwise quite consistent. As with the outcomes for traffic fatalities, my findings here have striking practical significance. Using the coefficients in model #1, a one-standard-deviation increase in the social capital variable equates to a 17% decline in crashes, a 22% decline in serious injuries, and a 37% decline in pedestrian fatalities.

Robustness Tests

To further corroborate my results, I run several robustness checks. First, I examine the effect of using different measures of social capital. As discussed in Section II, social capital may be thought of as a stock that is the product of various investments in the community and the polis. My first alternative variable, a social capital investment index, attempts to measure these investments directly. The index sums four components: electoral turnout, church attendance, club meeting attendance, and volunteer activity. I choose these components because they cover the three most influential areas of community engagement (described, e.g., by Putnam 2000): political participation, religious participation, and civic participation. Each component is measured by state by year and is standardized to zero mean and unit variance prior to summing.[11]

In Table 6, I present the results of instrumental variables estimation, replacing the "most people are honest" variable with my social capital investment index. While the results are somewhat less significant than for the honesty variable, the coefficients on the investment index are consistently negative and are significant in the majority of cases.

As a further check on sensitivity to specification choice, I re-run the models again, this time incorporating an alternative measure of generalized trust as my social capital variable. The new measure consists of the percentage of people by state that agree with the statement, "Most people can be trusted."[12] Data for this variable came from the *Bowling Alone* website of Robert Putnam, who obtained the data in individual response format from the General Social Survey (GSS) and produced averages over the period 1972-1996 for 41 states.[13] To ensure a complete sample of states for the present study, I filled missing state observations with corresponding sample-weighted regional averages from the GSS covering 1996-2006. This variable is a static measure; that is, it varies only by state, not by year. While I do not present the results here in the interests of space, they are quite consistent with my findings for both the honesty variable and the social capital investment index. The coefficient on the GSS-based trust variable is consistently negative, and it is strongly statistically significant in all runs involving total fatalities and crashes. For the runs involving serious injuries and pedestrian fatalities, the social capital effect is significant except in runs incorporating the state-specific linear time trend.

As a last robustness test, I consider sensitivity of the results for pedestrian fatalities to my approach of adjusting to "1" the observations on that variable that take a value of zero. I try instead an alternative observation-preserving adjustment of the zero values to a value of 0.1. The results are essentially unchanged as to sign and significance, though the coefficients are in general slightly larger using the alternative adjustment.

VII. CONCLUSIONS

This paper has provided robust evidence that social capital positively impacts highway safety. Trust and, to a lesser extent, a measure of social capital investment are found to be significantly negatively related to the incidence of crashes, injuries and deaths on the roads. The credibility of the causal link between social capital and traffic incident outcomes is bolstered by an identification strategy that leverages exogenous climatic variation. The results parallel prior findings with respect to social capital's beneficial effects on economic growth and various health outcomes.

In considering implications for public policy, it is important to ask whether, without policy intervention, agents would generate an optimal amount of social capital from the perspective of traffic incident mitigation. The answer appears to be no. Driving on public roads poses a commons problem: people do not generally "own" all the effects of their actions and so devote insufficient effort to safe driving from the perspective of social welfare. Two factors in this are tort liability rules, which allow drivers to escape liability for damage in crashes unless their care level is shown to fall short of a negligence standard; and the use in many states of no-fault systems, rather than negligence rules, to determine liability in vehicle crashes (White 2004). A commons problem also characterizes personal investment in social capital: when a person contributes to social connections and resources, others benefit from these contributions as well, which is to say the individual is unable to reap all the benefits herself. In short, positive externalities associated with driving care and social capital investment result in both activities being underprovided. A policy initiative to foster social capital investment could potentially address this problem and save lives.

A number of prospective approaches to stimulating investment in social capital are discussed in the literature. One approach is education policy. Knack and Keefer (1997) and Glaeser (2001) observe that social capital is robustly correlated with years of schooling. But whether any causal inferences can be drawn from this relationship is unclear. Moreover, policy implications are muddled by the possibility that it is the individual's relative, not absolute, education level that influences individual investment in social capital (Nie et al. 1996). It is usually the best educated people in a society that exhibit the greatest individual-level measures of social capital, but one cannot conclude from this whether a policy that raises the average education levels across a population would be effective at promoting social capital. Recent evidence from Helliwell and Putnam (2007) suggests, however, that social capital increases with both relative and average education levels.

Noting the importance of time horizons to the decision to invest in social capital, Glaeser (2001) argues that a public policy that encourages home ownership could, by creating more permanent communities, foster greater incentives for individuals to invest in social capital. To put it simply, one is more likely to see a return on one's investment, and therefore invest, if one expects to stay in the community longer. More generally, any policy that creates incentives for, or fertile ground for, "taking stock" in community should help to foster social capital and generate its benefits.

While these ideas show promise, more work needs to be done to develop actionable policies based on social capital formation. As measurement of social capital's effects continues, and the measurement methodologies become more sophisticated and more widely accepted, a larger role for social capital in the policymaking arena may well be the result.

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[1] On health, see Kawachi et al. (2004) for a survey. For evidence on well-being, see Helliwell and Wang (2011).

[2] In his study of the fatality risks posed by light trucks relative to cars, Gayer (2004) pioneered both the use of snow depth as an instrument (in his case, for vehicle miles traveled by vehicle type) and the use of restriction to summer crashes to ensure validity of the instrument.

[3] Snow depth does likely affect the rate of accidents in the summer indirectly through vehicle choice. Gayer's (2004) study, in fact, demonstrates exactly this: he finds that snow depth instrumenting for light-truck miles traveled has a positive influence on summer traffic incidents. However, I find that snow depth instrumenting for social capital has a *negative* influence on summer traffic incidents, thus the violation of the exclusion criteria represented by vehicle choice only works to bolster my identification strategy. See Section III.

[4] Some exploratory work has suggested that social capital may explain traffic fatalities. Using OLS on international data, Helliwell (2007) finds that traffic fatalities per capita vary negatively with the percent of people who believe that others can be trusted and with the number of memberships per capita in nonreligious voluntary organizations. In a study of Japan, Yamamura (2008) finds a negative but insignificant effect of the number of community centers by prefecture on the rate of traffic fatalities.

[5] An extensive literature on traffic fatalities based on aggregate data has covered a range of causal factors and correlates. Economic analyses have addressed key policy variables, often with U.S. applications (e.g., Loeb 1987, Keeler 1994, Ruhm 1996). Recent international studies have examined how traffic fatality rates vary as economies develop (e.g., van Beeck et al. 2000, Kopits and Cropper 2005, Anbarci et al. 2006, Bishai et al. 2006) or have used qualitative approaches to categorize countries based on relative levels or changes in the level of highway safety and potential correlative factors (e.g., Melinder and Andersson, 2000, 2001; Page, 2001; and Melinder, 2007).

[6] Helliwell (2009) tells of asking a seminar audience in Halifax, Nova Scotia what they would think if a driver "gave them the finger" in traffic. An audience member responded, "Aye, that'd be someone from out of town."

[7] All DDB Life Style data were provided to me through the generosity of DDB Worldwide of Chicago, who retain all rights to the data, including copyright. Copyright 1997-2006 by DDB Worldwide.

[8] Glaeser et al. (2000) find that responses to the standard trust survey question do a better job of predicting trustworthiness than trust. While the interpretation of results based on using a measure of trustworthiness would differ slightly from using a measure of trust, both provide a reasonable representation of the role that social connectedness plays in highway safety, relative to the conceptualization discussed in Section II.

[9] Oberholzer-Gee and Strumpf (2007) use a similar method to test the mechanism of their instruments for music downloads in a study of the influence of music downloads on album sales.

[10] Note that, if the commute reduction effect of snow dominates, this suggests additionally that winter snow might reduce summer traffic incidents by shrinking driving regimens year-round. I will avoid the potential problem this poses for my identification strategy by including vehicle miles traveled per person as a control variable in the main IV model. See Section VI.

[11] Detailed descriptions of the component measures and their data sources are available from the author on request.

[12] The precise question asks respondents to indicate if they believe "most people can be trusted," or if, instead, it is truer to say that "you can't be too careful."

[13] See Putnam (2000, 290-91).

TABLE 1

Summary Statistics - Traffic Incidents, Social Capital, and Snow Depth Variables (N=480)

Variable	Mean	St. Dev.	Min.	Max
Summer traffic incidents				
Fatalities	240.02	215.67	17	1236
Crashes	213.89	190.96	16	1061
Serious injuries	329.93	289.81	26	1584
Pedestrian fatalities	22.86	30.13	0	174
Social capital				
"Most people are honest" (6-level agree scale)	3.56	0.19	2.84	4.16
Snow depth (in inches)				
Average daily snow depth - Jan., Feb., Mar., Oct., Nov., Dec.	1.33	1.86	0.00	10.90
Maximum snow depth for the year, averaged across stations	6.95	6.09	0.00	38.76

Note: Observations in the panel data set consist of a given state in a given year between 1997 and 2006. The count of serious injuries includes fatalities. All statistics for pedestrian fatalities are prior to adjustment of the zero-valued observations on the variable.

TABLE 2

Commute Time: Relation to Snow Depth and Impact on Social Capital

	(1)		(2)		(3)		(4)	
Dependent Variable	Log % People with Commute < 10 Minutes (1st Stage)	Social Capital (2nd Stage)	Log % People with Commute < 10 Minutes (1st Stage)	Social Capital (2nd Stage)	Log % People with Commute < 15 Minutes (1st Stage)	Social Capital (2nd Stage)	Log % People with Commute < 15 Minutes (1st Stage)	Social Capital (2nd Stage)
Average daily snow depth	0.069***				0.047**			
	(0.025)				(0.019)			
Average maximum daily snow depth			0.026***				0.018**	
			(0.009)				(0.007)	
Log % people with short commute		0.436***		0.490***		0.639***		0.719***
		(0.091)		(0.109)		(0.176)		(0.195)
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	48	48	48	48	48	48	48	48
Mean of dependent variable	-1.78	3.56	-1.78	3.56	-1.12	3.56	-1.12	3.56

Note: Cross-sectional IV analysis of state data using means over sample period for snow depth and social capital. Commute time is 2005-2007 3-year estimate from the U.S. Census. Robust standard errors allowing for clustering within regions are in parentheses.

***Significant at 1% level　　**Significant at 5% level

FIGURE 1
Social Capital vs. Share of Workers with Short Commutes

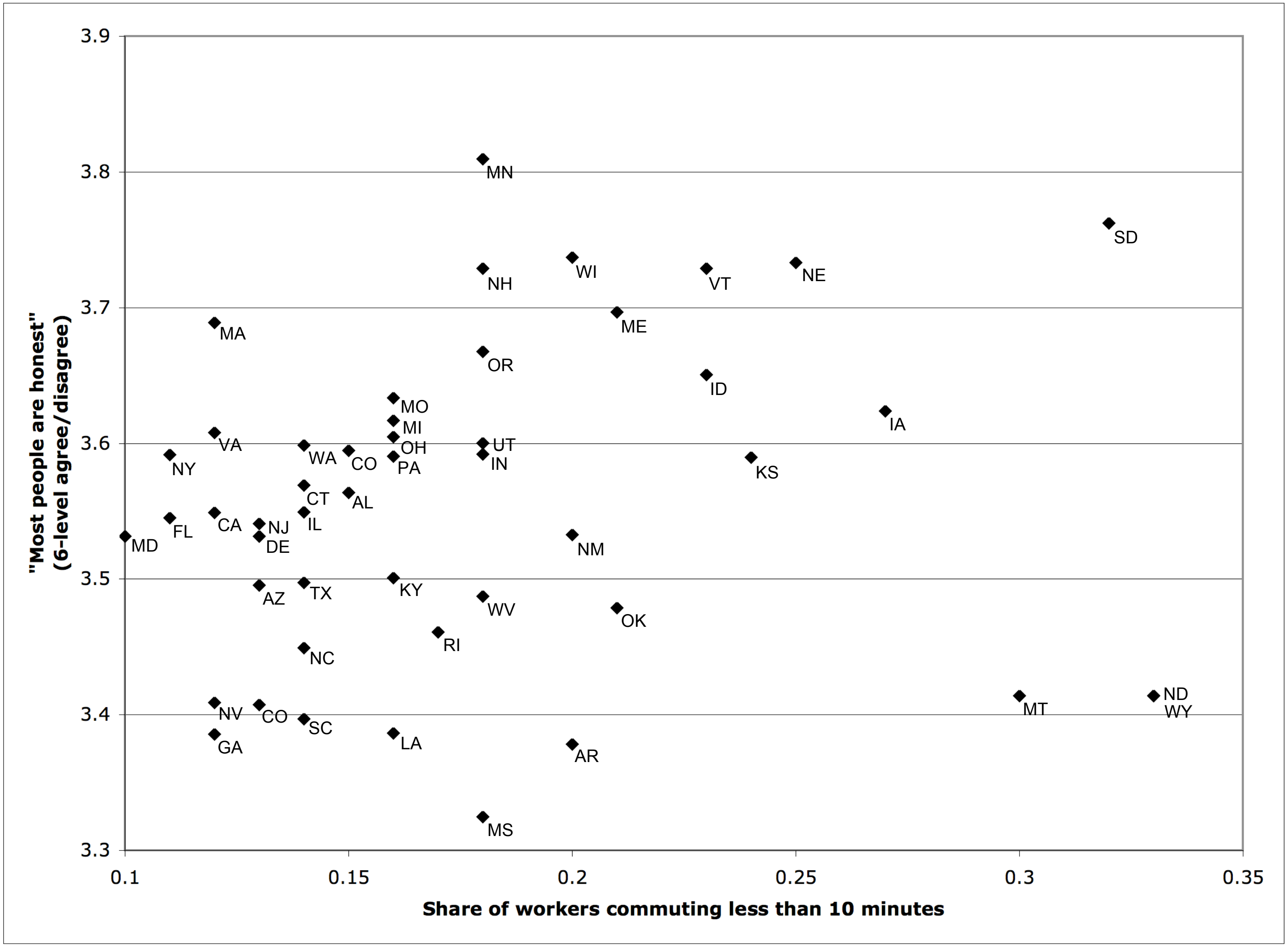

TABLE 3

OLS: Social Capital and Traffic Fatalities

	(1)	**(2)**	**(3)**	**(4)**
Social capital (agree "most people are honest")	-0.310***	-0.340***	-0.182**	-0.208***
	(0.114)	(0.120)	(0.076)	(0.075)
Time trend	Yes	No	No	No
Year indicators	No	Yes	No	Yes
State-specific linear time trend	No	No	Yes	Yes
Observations	480	480	480	480
R-squared	0.9600	0.9609	0.9818	0.9823

Notes: Dependent variable is the natural log of traffic fatalities occurring in the summer months (June, July, and August). Each model controls for (in log form) real gross state product per capita, vehicle miles traveled per capita, state population, unpaved roads as a percent of local road mileage, gas stations per 1,000 population, population per mile of road (in thousands), percent of population age 65 and over, and the maximum state speed limit. Robust standard errors allowing for clustering within states are in parentheses.

***Significant at 1% level **Significant at 5% level

TABLE 4

IV: Social Capital and Traffic Fatalities

	(1)		(2)		(3)		(4)	
	1st Stage Social Capital	2nd Stage Log Fatalities	1st Stage Social Capital	2nd Stage Log Fatalities	1st Stage Social Capital	2nd Stage Log Fatalities	1st Stage Social Capital	2nd Stage Log Fatalities
Social capital (agree "most people are honest")		-1.065***		-0.973***		-0.765***		-0.632***
		(0.261)		(0.236)		(0.217)		(0.175)
Average daily snow depth	0.029***		0.033***		0.021***		0.028***	
	(0.006)		(0.005)		(0.006)		(0.006)	
Time trend	Yes	Yes	No	No	No	No	No	No
Year indicators	No	No	Yes	Yes	No	No	Yes	Yes
State-specific linear time trend	No	No	No	No	Yes	Yes	Yes	Yes
F-statistic	26.408		40.427		13.711		20.205	
Partial R-squared	0.0794		0.1088		0.0370		0.0695	
Observations	480	480	480	480	480	480	480	480
R-squared		0.9411		0.9487		0.9750		0.9792
	(5)		(6)		(7)		(8)	
Social capital (agree "most people are honest")		-1.141***		-1.036***		-0.780***		-0.616***
		(0.254)		(0.220)		(0.202)		(0.159)
Average maximum daily snow depth	0.010***		0.011***		0.008***		0.010***	
	(0.002)		(0.002)		(0.002)		(0.002)	
Time trend	Yes	Yes	No	No	No	No	No	No
Year indicators	No	No	Yes	Yes	No	No	Yes	Yes
State-specific linear time trend	No	No	No	No	Yes	Yes	Yes	Yes
F-statistic	22.049		31.521		12.275		20.387	
Partial R-squared	0.1007		0.1341		0.0468		0.0831	
Observations	480	480	480	480	480	480	480	480
R-squared		0.9371		0.9462		0.9746		0.9794

Notes: Dependent variable in the second stage is the natural log of traffic fatalities occurring in the summer months (June, July, and August). Each model controls for (in log form) real gross state product per capita, vehicle miles traveled per capita, state population, unpaved roads as a percent of local road mileage, gas stations per 1,000 population, population per mile of road (in thousands), percent of population age 65 and over, and the maximum state speed limit. Robust standard errors allowing for clustering within states are in parentheses.

***Significant at 1% level

TABLE 5

IV: Effect of Social Capital on Traffic Incidents of Different Types

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable (log of):								
Summer traffic fatalities	-1.065***	-0.973***	-0.765***	-0.632***	-1.141***	-1.036***	-0.780***	-0.616***
	(0.261)	(0.236)	(0.217)	(0.175)	(0.254)	(0.220)	(0.202)	(0.159)
	{0.9411}	{0.9487}	{0.9750}	{0.9792}	{0.9371}	{0.9462}	{0.9746}	{0.9794}
Summer crashes	-0.971***	-0.886***	-0.657***	-0.543***	-1.036***	-0.944***	-0.646***	-0.518***
	(0.246)	(0.224)	(0.207)	(0.164)	(0.235)	(0.207)	(0.199)	(0.158)
	{0.9466}	{0.9528}	{0.9776}	{0.9807}	{0.9435}	{0.9507}	{0.9778}	{0.9810}
Summer serious injuries	-1.315***	-1.210***	-0.886***	-0.753***	-1.238***	-1.130***	-0.795***	-0.641***
	(0.290)	(0.258)	(0.283)	(0.226)	(0.278)	(0.235)	(0.241)	(0.185)
	{0.9076}	{0.9194}	{0.9664}	{0.9720}	{0.9130}	{0.9239}	{0.9690}	{0.9741}
Summer pedestrian fatalities	-2.417***	-2.256***	-1.402	-1.233	-2.626***	-2.422***	-1.853*	-1.526*
	(0.517)	(0.505)	(1.131)	(0.831)	(0.539)	(0.493)	(1.092)	(0.805)
	{0.7785}	{0.7977}	{0.8773}	{0.8859}	{0.7654}	{0.7895}	{0.8630}	{0.8794}
Instrumental variable:								
Average daily snow depth	x	x	x	x				
Average maximum daily snow depth					x	x	x	x
Time trend	Yes	No	No	No	Yes	No	No	No
Year indicators	No	Yes	No	Yes	No	Yes	No	Yes
State-specific linear time trend	No	No	Yes	Yes	No	No	Yes	Yes

Notes: Second-stage results are presented for different dependent variables reflecting various traffic incidents occurring in the summer months (June, July, and August). Results show coefficient on social capital variable, measured as level of agreement with "most people are honest." Each model controls for (in log form) real gross state product per capita, vehicle miles traveled per capita, state population, unpaved roads as percent of local road mileage, gas stations per 1,000 population, population per mile of road (in thousands), percent of population age 65 and over, and the maximum state speed limit. N=480 for all models. Robust standard errors allowing for clustering within states are in parentheses. R-squared for second stage are reported in braces.

***Significant at 1% level *Significant at 10% level

TABLE 6
IV: Effect of Social Capital (Investment Index) on Traffic Incidents of Different Types

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable (log of):								
Summer traffic fatalities	-0.159**	-0.139***	-0.249	-0.142*	-0.180**	-0.150***	-1.480	-0.212
	(0.065)	(0.048)	(0.283)	(0.086)	(0.074)	(0.050)	(9.125)	(0.175)
	{0.9096}	{0.9351}	{0.8843}	{0.9630}	{0.8930}	{0.9299}	{†}	{0.9365}
Summer crashes	-0.145**	-0.127***	-0.213	-0.122*	-0.164**	-0.137***	-1.226	-0.179
	(0.060)	(0.045)	(0.239)	(0.072)	(0.069)	(0.047)	(7.559)	(0.150)
	{0.9211}	{0.9418}	{0.9122}	{0.9694}	{0.9079}	{0.9375}	{†}	{0.9516}
Summer serious injuries	-0.196***	-0.173***	-0.288	-0.170*	-0.196**	-0.164***	-1.509	-0.221
	(0.075)	(0.055)	(0.313)	(0.091)	(0.079)	(0.052)	(9.274)	(0.177)
	{0.8678}	{0.9051}	{0.8524}	{0.9535}	{0.8684}	{0.9110}	{†}	{0.9328}
Summer pedestrian fatalities	-0.361**	-0.323***	-0.455	-0.278	-0.415**	-0.350***	-3.517	-0.526
	(0.154)	(0.121)	(0.754)	(0.288)	(0.169)	(0.120)	(22.563)	(0.563)
	{0.6928}	{0.7584}	{0.7248}	{0.8614}	{0.6422}	{0.7417}	{†}	{0.7509}
Instrumental variable:								
Average daily snow depth	x	x	x	x				
Average maximum daily snow depth					x	x	x	x
Time trend	Yes	No	No	No	Yes	No	No	No
Year indicators	No	Yes	No	Yes	No	Yes	No	Yes
State-specific linear time trend	No	No	Yes	Yes	No	No	Yes	Yes

Notes: Second-stage results are presented for different dependent variables reflecting various traffic incidents occurring in the summer months (June, July, and August). Results show coefficient on social capital variable, measured as investment index (sum of four standardized measures of investment in social capital). Each model controls for (in log form) real gross state product per capita, vehicle miles traveled per capita, state population, unpaved roads as percent of local road mileage, gas stations per 1,000 population, population per mile of road (in thousands), percent of population age 65 and over, and the maximum state speed limit. N=480 for all models. Robust standard errors allowing for clustering within states are in parentheses. R-squared for second stage are reported in braces.

***Significant at 1% level **Significant at 5% level *Significant at 10% level

† R-squared is negative.