LONELY HIGHWAYS: THE ROLE OF SOCIAL CAPITAL IN RURAL TRAFFIC SAFETY

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Earlier work has found that social capital reduces traffic fatality risk (Nagler 2013a, Nagler 2013b). Recognizing that rural areas suffer from high traffic fatality levels despite a perceived high density of communal ties, we explore here whether social capital provides the same protection against traffic risks on rural roads as on urban roads, and what factors might explain differential effects. We estimate simultaneous equation systems of complementary traffic incident types on a 10-year panel of 48 U.S. states. Our results show that social capital has a significantly lower protective effect on rural roads than urban roads; in fact, the protective effect is altogether insignificant on rural roads. Potentially relevant differentials in crash-type/context exposure (single- vs. multi-vehicle, junction- vs. non-junction) do not mediate this outcome. Rather it appears that the relative prevalence of certain risk behaviors, such as speeding, skew rural environments toward crash situations in which the critical safety factors are orthogonal to social capital influence.

Keywords: social capital, trust, rural culture, risk behavior, driver care.

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INTRODUCTION

Fatalities from traffic crashes constitute a peculiarly *rural* public health problem. In 2010, rural areas accounted for only 19% of the population of the United States, but 55% of all traffic fatalities [NHTSA 2012]. In that year, the traffic fatality rate per vehicle mile traveled in the U.S. was 2.5 times higher in rural areas than urban areas [NHTSA 2012]. Correspondingly, the traffic fatality risk per capita and per vehicle mile traveled is higher in those states that have a higher percentage of travel on rural classified roads (see Figure 1). Internationally, the rural traffic fatality problem has reached what may be reasonably characterized as a crisis. Within the 13 countries of the Organization for Economic Co-operation and Development (OECD), 60% of all traffic fatalities occurred on rural roads in 1996, the most recent year for which international data were available, up from less than 55% in 1980 [OECD 1999]. The deaths, on order of 75,000 per year, have been associated with an estimated economic cost of US$135 billion per year. Whereas urban traffic fatalities in the OECD countries declined from 1980 to 1996, the number of rural traffic fatalities increased by 5%, suggesting that there is a rural traffic safety problem that "has been neglected over the years … is very serious … and clearly requires priority attention." [OECD 1999, p. 9]

< PLACE FIGURE 1 APPROXIMATELY HERE>

The analysis of rural traffic safety, in view of the current state of knowledge of the key factors that impact it, poses a puzzle. On the one hand, several factors, including risks posed by the rural physical environment, longer response times for emergency medical services, and a culture of risk-taking and risk-denial that leads to a greater tendency among drivers to engage in high-risk behaviors (e.g., speeding, alcohol use) combined with a decreased tendency to engage in protective behaviors (e.g., seatbelt compliance), contribute to higher fatality rates [Ward 2007;

Eiksund 2009; Rakauskas et al. 2009; Coogan et al. 2010; NHTSA 2012]. On the other hand, rural communities are perceived as enjoying greater *social capital* – that is, stronger communal social ties – than urban communities [Weisheit et al. 2006]. The logic of this perception relates to parochialism: the notion that the restricted mobility and insularity promotes reputation, retaliation, and segmentation, forces that raise the net benefits to individual behaviors that benefit the larger group [Bowles and Gintis 1998]. Recent studies by Nagler [2013a; 2013b] have connected social capital with improved traffic safety, providing as potential explanations the effects of social capital in increasing courteous driving behavior, encouraging conscientious vehicle choices, and promoting more efficient safety-law enactment and enforcement.[1] Why, then, if social capital's protective effects exist equally in rural areas as elsewhere, are the rates of traffic fatality in rural areas so persistently high?

In this paper, using data from the United States for the period 1997-2006, we build on the previously observed relationship between social capital and traffic fatality risk by examining the implications of this relationship within rural environments. We begin by exploring briefly whether there is truth to the notion that social capital is greater in rural areas; for this purpose, we examine a simple bivariate correlation between state-level social capital measures and various proxies for a state's "rural-ness." Our tentative finding from this exploratory analysis is that social capital is in fact *no higher* in states that are "more rural." We move on to the core of our investigation, in which we apply and extend the econometric approaches used by Nagler [2013a; 2013b] to examine whether social capital's protective effects have equivalent force with respect to fatalities occurring on rural and urban roads. To probe the question further, we explore the

[1] A substantial literature has previously connected interpersonal trust and civic engagement at an individual and group level to a number of positive economic impacts [Narayan and Pritchett 1999; Knack 2001; Zak and Knack 2001; Grootaert et al. 2002; Karlan et al. 2009]. Social capital, measured variously, has also been shown to have beneficial impacts on health [for a survey, see Kawachi et al. 2004] and well-being [Helliwell and Wang 2011].

potential mediating effects of specific crash types and contexts and of behavioral risk factors on the relative protective effect of social capital on rural and urban roads. We find that social capital has a significantly lower protective effect on rural roads than urban roads; in fact, the protective effect is altogether insignificant on rural roads. Potentially relevant differentials in crash-type (i.e., single- vs. multi-vehicle crash) and crash-context (i.e., junction- vs. non-junction related) exposure between rural and urban road settings do not mediate this outcome. Rather, our findings are consistent with the possibility that the relative prevalence of certain risk factors, such as speeding, skew rural environments toward crash situations in which the critical safety factors are orthogonal to social capital influence.

The next section introduces our data. We then proceed to describe our empirical strategy. Results are presented, and then subsequently discussed. A brief final section concludes.

DATA

Data on fatalities in motor vehicle crashes for the 48 contiguous United States were obtained from the Fatality Analysis Reporting System (FARS) of the National Highway Traffic Safety Administration (NHTSA) for the years 1997-2006.[2] All counts were limited to fatalities in crashes occurring during the summer months of June, July, and August, for reasons outlined in our empirical strategy below. Fatalities were grouped separately for crashes occurring on rural- and urban-classified roads. Within those categorizations, the fatalities were counted based on whether the associated crash involved a single vehicle or multiple vehicles, and whether it occurred at a junction-related or non-junction-related location. Fatalities were also counted on all

[2] While data are currently available from FARS through 2012, the period ending 1996 was chosen to achieve alignment with the available data used to develop social capital measures.

roads (i.e., pooling rural- and urban-classified roads) based on whether the associated crash was speeding-related or not, whether driver alcohol use was involved or not,[3] and whether the fatally-injured person was wearing a seatbelt or not.[4]

Our choice of corresponding data on social capital (i.e., by state by year for 1997-2006) requires some discussion. Literatures in political science, sociology, and communication discuss the measurement of social capital [e.g., Williams 2006; Hanson et al. 2008; Keele 2007; Hawes et al. 2012]. Many of the methodologies employed relate to relationships at the individual level and are therefore inappropriate for measuring social capital differences between geographies. A helpful starting point for state-level measurement is Harpham et al.'s [2004] conceptualization of social capital as comprising a *structural* component – social networks, connections, and resources – and a *cognitive* component – a set of perceptions and attitudes. This conceptualization is consistent with Lynch and Kaplan's [1997, p. 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." Both the structural and cognitive components of social capital exhibit the capacity to be measured at an aggregate level, as Putnam's [2000, p. 291] collection of investment-oriented and attitude-oriented social capital measures attest. However, some of Putnam's measures are static and so do not meet the desirable criterion of being able to identify variation both across states and over time [Hawes et al. 2012].

We measure social capital in two ways.[5] For our first measure, we use voter turnout, measured as the state-level turnout rate (as a percent) of the voting eligible population for the

[3] In the FARS data, alcohol involvement in crashes is measured for drivers and vehicle non-occupants (e.g., pedestrians, bicyclists). We have assumed that all alcohol involvement is attributable to the driver, so our data suffer from some measurement error (i.e., over-attribution of alcohol use to drivers). This constitutes, we believe, a minor limitation of our data.
[4] Counts were obtained based on each of the grouping criteria separately. Counts based on intersections of the criteria (e.g., fatalities in single-vehicle, junction-related crashes) were not obtained.
[5] The use of two alternative approaches to measuring social capital is intended to lend robustness to the analysis.

highest office election for the year. “Highest office” refers to the presidential election in presidential election years, and either the gubernatorial (if any) or congressional election in other even-numbered years. Data were obtained from the United States Elections Project for even-numbered years in the sample period.[6] To obtain values for odd-numbered years, and to eliminate “seasonality” due to the greater turnout accruing to presidential elections, we set observations equal to an average of the nearest presidential election year turnout and nearest even-numbered non-presidential election year turnout. Where two years were equidistant from the year in question (i.e., when setting values for even-numbered years), their values were averaged. Voter turnout provides a measure of social capital *investment*, in that it represents activity by individuals to foster stronger social institutions and connections.[7] It has been utilized by Putnam [2000] as one of his investment-oriented social capital measures and is incorporated as a component in his 14-component Comprehensive Social Capital Index [p. 291].

As a second, *attitude*-based metric, we 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.”[8] The DDB Life Style Data are utilized and discussed extensively by Putnam [2000]; this particular trust metric is incorporated by Putnam as a component in his index [p. 291]. Individual responses were reported on a 6-point agree/disagree scale, with “6” representing the greatest level of agreement with the statement. We averaged responses within each state-year

[6] http://elections.gmu.edu/voter_turnout.htm. This same source was used by Putnam [2000] to obtain his voter turnout data.

[7] Nagler [2013a; 2013b] uses a social capital investment index that sums four components: voter turnout, church attendance, club meeting attendance, and volunteer activity. These components were selected because they cover the three most influential areas of community engagement (described by Putnam [2000]): political participation, religious participation, and civic participation. We elected here to use *only* the voter turnout component; our purpose was to avoid the interpretation complexities involved with a composite index and, more specifically, because of the four components used by Nagler only voter turnout does not also indicate increased regular travel by motorists, which might introduce confounding effects on traffic fatalities.

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

using sample weights to obtain the variable for use in the study. Because this variable was characterized by low survey response rates for some smaller states, we used a two-part strategy to ensure a reliable, complete set of state-year averages. First, for four low-count states, we replaced state-year averages with averages from higher-count adjacent states. The general advantages of this method, known as deterministic hot-deck imputation, are discussed by Andridge and Little [2010]; our selection of adjacent states for the imputation was motivated by the recognition that states tend to have similar characteristics to their neighbors. A list of the affected states along with the states that provided corresponding replacement values is offered in Table 1. The second part of our strategy involved taking a 3-year moving average of all state-year observations, weighted by the response count for each state in each year.

< PLACE TABLE 1 APPROXIMATELY HERE >

Table 2 indicates the states in our sample that rank highest and lowest based on our two measures of social capital. The lists provide few surprises: most of the highest-ranking states are in the upper Midwest, while the lowest-ranking are largely within the Deep South and South Central Region. These findings are consistent with Putnam's [2000, p. 292] characterizations of "high-pressure" and "low-pressure" zones with respect to social capital, based on his social capital index.

< PLACE TABLE 2 APPROXIMATELY HERE >

Table 3 presents summary statistics for our traffic fatality and social capital variables. For our measures of traffic fatalities, which are count variables, we present the number of zero values alongside the usual statistics.

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EMPIRICAL STRATEGY

Is social capital greater in rural than urban areas?

To investigate whether social capital is greater in states that are more rural, the two measures of social capital were correlated (Pearson R; one-tailed) with four proxy-measures of a state's "rural-ness," based on observations for the 48 contiguous United States corresponding to the year 2006. The proxy-measures included: percentage of the population of the state living in rural areas, population of the state's capital city, percentage of total road mileage classified as rural, and percentage of vehicle miles traveled on rural-classified roads.[9] A rejection in the one-tailed t-test (i.e., of a hypothesis of zero correlation) would be taken as indicating a significant positive correlation between state-level social capital and rural-ness.

Does social capital have an equal protective effect on rural and urban roads?

To estimate social capital's potential differential effect with respect to fatalities occurring on urban and rural roads, we use simultaneous equations systems of complementary traffic incident types as described in detail by Nagler [2013b]. Our measures of traffic incidents – in the present study, the fatalities occurring in various categories of traffic crash – are count variables involving a finite number of occurrences. As Table 3 indicates, the average counts for our fatality variables are not especially low, while the incidence across our sample of zero values *is* quite low. As such, the determination of fatality incidents may be appropriately modeled using a continuous dependent variable based on a normal distribution rather than by a Poisson process.[10]

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[9] Among the most rural states (i.e., ranking in the top three based on two or more of our measures) are South Dakota, Vermont, Maine, and Montana. The most urban are New Jersey, Rhode Island, and Massachusetts.
[10] Kennedy [2008, p. 254] points out that as the number of counts becomes large, the Poisson approaches a normal distribution. In line with this, Bishai et al. [2006] posit a log-log specification based on a normal distribution,

The basic approach accounts both for the formation of social capital and its role in traffic incidents, employing two complementary incident types, as represented by the following specification:

$$
\begin{aligned}
&\log\left(y_{it}^{a}\right)=\alpha^{a}S_{it}+\sum_{j}\beta_{j}^{a}X_{ijt}+\varepsilon_{it}^{a}\\
(1)\qquad &\log\left(y_{it}^{b}\right)=\alpha^{b}S_{it}+\sum_{j}\beta_{j}^{b}X_{ijt}+\varepsilon_{it}^{b}\\
&S_{it}=\sum_{j}\gamma_{j}X_{ijt}+\xi_{it}
\end{aligned}
$$

Here, y_{it}^{k} consists of the count of the relevant incidents of type *k* $\left(k=a,b\right)$ occurring in state *i* and year *t*, with corresponding unobservable determinants of incidents ε_{it}^{k}. S_{it} represents a measure of social capital, the X_{ijt} are other observed characteristics, and ξ_{it} are unobservable determinants of social capital. In the version of this equation system used for examining whether social capital has an equal protective effect on urban and rural roads, the complementary incident types *a* and *b* consist of crash fatalities occurring on rural-classified roads versus fatalities occurring on urban-classified roads.

The unobservable determinants of different types of traffic incidents are likely correlated, thus efficient estimation of (1) will require us to somehow account for $E\left(\varepsilon_{it}^{a},\varepsilon_{it}^{b}\right)\neq 0$. Furthermore, consistent estimation of (1) requires that $E\left(\varepsilon_{it}^{a},\xi_{it}\right)=E\left(\varepsilon_{it}^{b},\xi_{it}\right)=0$. This is likely to be violated, in that unobservable differences in the distribution of individuals' characteristics across states likely influence both the level of social capital and the incidence of traffic fatalities. It is quite possible, for example, that individual tendencies toward courteous driving and civic

consistent with the low incidence of zero counts in their country-level fatality data. Keeler [1994] estimates a model of traffic fatalities using a Poisson process, but his unit of analysis is the county level in the United States; accordingly his counts are lower and the incidence of zero values likely much higher than those observed in a state or country study.

responsibility are correlated, such that states with more reckless and discourteous drivers have a lower rate of selection into activities of social or civic engagement. If true, this would bias the estimation of coefficients in the incidents equations in (1).

One may eliminate the bias by using 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 that would arise from an experimental process. We employ snow depth for this purpose. Nagler [2013a] provides empirical evidence supporting the conceptual basis for using snow depth as an instrument for social capital – specifically, that snow depth influences the long-term movement patterns of individuals, which in turn play a role in social capital formation. Using two-stage least squares (2SLS) estimation on a cross-section of states, Nagler [2013a] finds that average snow depth has a strong positive effect on the share of people with short commute times, and that the instrumented short commute time-share in turn influences social capital positively and significantly. The article also shows that snow depth has strong explanatory power with respect to social capital, presenting F-statistics for snow depth as an instrumental variable and partial R^2 for the first-stage estimation of a social capital equation employing snow depth as an instrument within a two-stage system.

To be a consistent instrument, snow depth must also be independent of the number of traffic fatalities. Given that snow makes roads less safe for driving, this condition is not met. We address this "exclusion restriction" problem in the manner of Gayer [2004], who also uses snow depth as an instrument in a traffic safety regression, by limiting our traffic incident measures to fatalities occurring in the summer months. That is, in (1), we replace y_{it}^{k} with $\tilde{y}_{it}^{k}$, which counts the relevant traffic incidents occurring in state *i* in June, July, or August of year *t*. The estimated version of the three-equation system becomes

(2)
$$\begin{aligned}\log\left(\tilde{y}_{it}^{a}\right) &= \alpha^{a}\hat{S}_{it} + \sum_{j}\beta_{j}^{a}X_{ijt} + \tilde{\varepsilon}_{it}^{a}\\ \log\left(\tilde{y}_{it}^{b}\right) &= \alpha^{b}\hat{S}_{it} + \sum_{j}\beta_{j}^{b}X_{ijt} + \tilde{\varepsilon}_{it}^{b}\\ S_{it} &= \delta Z_{it} + \sum_{j}\gamma_{j}X_{ijt} + \xi_{it}\end{aligned}$$

where $\tilde{\varepsilon}_{it}^{k}$ $\left(k = a,b\right)$ represents the unobservable determinants of the relevant incidents occurring in the summer. Estimation is by the three-stage least squares (3SLS), which allows us to account both for the endogeneity of social capital *and* the relationship of the complementary traffic incident types.[11]

Control variables X_{ijt} are incorporated in log form, following previous work on the determinants of traffic incidents by Kopits and Cropper [2005] and Bishai et al. [2006]. Each of the three equations in the estimated equation system 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.

A t-test is used to evaluate equality of the social capital coefficients α^{k}; rejection of the null hypothesis would indicate that social capital's effect on the incidence of rural road fatalities differs significantly from its effect on urban road fatalities.

[11] Validity checks for the snow depth instrument equivalent to those that were used in the 2SLS estimation performed by Nagler [2013a] are not available in 3SLS, because 3SLS generally provides a method for estimating a structural, rather than reduced-form, model. However, here we may rely confidently on the validity results from the prior 2SLS estimation in that those results verified instrument validity through estimation of a first-stage equation that is identical to the social capital equation in the present 3SLS framework.

Mediating effects of crash type and context

To examine the roles of crash type and context, we posit a five-equation variation on (2) that employs four complementary traffic incident types instead of two:

(3)
$$\begin{aligned}
\log\left(\tilde{y}_{it}^{a}\right) &= \alpha^{a} S_{it} + \sum_{j} \beta_{j}^{a} X_{ijt} + \tilde{\varepsilon}_{it}^{a} \\
\log\left(\tilde{y}_{it}^{b}\right) &= \alpha^{b} S_{it} + \sum_{j} \beta_{j}^{b} X_{ijt} + \tilde{\varepsilon}_{it}^{b} \\
\log\left(\tilde{y}_{it}^{c}\right) &= \alpha^{c} S_{it} + \sum_{j} \beta_{j}^{c} X_{ijt} + \tilde{\varepsilon}_{it}^{c} \\
\log\left(\tilde{y}_{it}^{d}\right) &= \alpha^{d} S_{it} + \sum_{j} \beta_{j}^{d} X_{ijt} + \tilde{\varepsilon}_{it}^{d} \\
S_{it} &= \sum_{j} \gamma_{j} X_{ijt} + \xi_{it}
\end{aligned}$$

As a first variant we separate the rural and urban crashes based on crash *type*; that is, whether they involved a single vehicle in transport or multiple vehicles. Thus the four complementary incident measures are fatalities in rural single-vehicle crashes, fatalities in rural multi-vehicle crashes, urban single-vehicle fatalities, and urban multi-vehicle fatalities. As a second variant we separate the rural and urban crashes based on crash *context*; namely, location as junction-related or non-junction-related. The purpose of the five-equation analysis is to determine whether any differentials found between social capital's effects on rural and urban roads persist once crash type (or context) is accounted for. If they do not, then any differences in effect between rural and urban roads may be attributed entirely to variation in crash type (or context). T-tests are used to evaluate the equality of social capital coefficients across the urban and rural equations within crash type/context.

Multi-vehicle and junction-related situations are presumed inherently to necessitate driver interaction, providing the opportunity for social capital to manifest effects. Our implicit hypothesis, then, is that social capital has less of an effect in the rural environment because rural environments have fewer intersections and a greater proportion of single-vehicle crashes than urban environments [NHTSA 1996].

Mediating effects of behavioral risk factors

Various risk behaviors vary in prevalence substantially between urban and rural environments. As an illustration of the some of the relative risks faced by motorists in rural areas, Table 4 displays the number of total fatalities from 1997 to 2006 on rural- and urban-classified roads identified with three risk behaviors believed commonly to differentiate rural and urban traffic safety levels: alcohol use, speeding, and seatbelt non-use. From these data, we have calculated risk ratios, which are presented below the corresponding fatality counts. The risk ratios indicate that the risks of speeding and seatbelt non-use having played a role in a fatality are significantly higher on rural than urban roads. (The risk ratio for alcohol indicates the risk of its having played a role in a fatality is significantly higher for *urban* roads.)

< PLACE TABLE 4 APPROXIMATELY HERE >

Differential effects of social capital across environments, where observed, could potentially be explained by the role the three risk behaviors play in crashes. To explore the possibility that risk behaviors play a mediating role, we compare the effect of social capital where these factors were and were not present. The resulting analysis uses three estimated equation systems based on the model in (2). In each case, t-tests are used to evaluate the equality of social capital coefficients where the risk behaviors were and were not present. A rejection in the t-test would indicate the possibility that differences observed in social capital's effects between the rural and urban environments might be attributable to the differential role of the relevant risk behavior in rural versus urban crashes.

For each of our regression specifications using (2) and (3) described above, eight versions were estimated: these vary based on which of our two measures of social capital they employ; and whether they add a general time trend, year indicators, a state-specific linear time trend, or both year indicators and a state-specific linear time trend. The indicators and time trends are intended to reduce selection bias by picking 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 versions used provide consistency with the approach of Nagler [2013a; 2013b] and so allow us to benchmark our findings against his earlier results.

RESULTS

Table 5 presents our findings concerning the question of whether social capital is significantly greater in rural than urban areas. As the table shows, while our two measures of social capital are significantly correlated with each other, the evidence indicates overwhelmingly that social capital does not increase significantly with higher indications of rural-ness. Only one in eight of the correlations in question yields a significant positive result at the 5% critical level. At the 1% level, all eight correlations are insignificant.

< PLACE TABLE 5 APPROXIMATELY HERE >

Table 6 displays our regression results relating to the question of whether social capital has an equivalent effect on rural and urban roads, based on estimation of the rural vs. urban equation system in (2). The coefficients displayed in the top section of the table represent the relationship between social capital and traffic fatality risk *within each road classification (urban* *or rural)*. These are all negative and significant in the equations representing fatalities on urban roads, but not significant, and of variable sign, in the equations representing fatalities on rural roads. The results of our tests for differences *between road classifications (urban vs. rural)* indicated that the urban coefficient was significantly larger (in absolute value) than the rural coefficient in 7 out of 8 of the equations. The results indicate that the protective effect of social capital on traffic safety is (1) stronger within urban-classified roads; and (2) significant within urban-classified roads, but not significant within rural-classified roads. Additionally we note that the snow depth coefficient is always positive and highly significant in the first-stage equation. Thus, consistent with its being a good instrument for social capital, snow depth is a significant determinant of social capital.[12]

< PLACE TABLE 6 APPROXIMATELY HERE >

Our results on the potential mediating effects of crash type are displayed in Table 7. The table presents regression outcomes for the equation systems that examine social capital's effect on rural and urban traffic fatality risk separately *within each crash type (multi-vehicle crash or single-vehicle crash)*. The coefficients on the social capital variables are significant and negative in all the urban equations involving multi-vehicle incidents and all but one involving single-vehicle incidents. The corresponding coefficients in the rural equations are insignificant in every case. Our t-test results comparing the coefficients between the rural and urban equations for the different crash types indicate that the protective effect of social capital is significantly stronger for urban crashes (15 out of 16 equations). Thus, social capital's differential protective effect between urban areas and rural areas persists when crash type is taken into account.

< PLACE TABLE 7 APPROXIMATELY HERE >

[12] For further discussion, see Empirical Strategy section above and Nagler [2013a].

Table 8 presents findings on the potential mediating effects of crash context. Here we display regression results for the equation systems that examine the effect of social capital on rural and urban traffic fatality risk separately *within each crash context (junction-related crash or non-junction-related crash)*. The coefficients on the social capital variables are significant and negative in 7 out of 8 of the urban equations involving junction-related crashes and all of the urban equations involving non-junction-related crashes. The corresponding coefficients in the rural equations are insignificant in all cases. Our test results comparing the coefficients between the rural and urban equations for the different crash contexts indicate that the protective effect of social capital is significantly stronger for urban crashes (14 out of 16 equations). Thus, social capital's differential protective effect between urban areas and rural areas persists when crash context is taken into account.

< PLACE TABLE 8 APPROXIMATELY HERE >

Finally, Table 9 presents regression results for the equation systems that examine social capital's effects in the presence and absence of each of the three included behavioral risk factors. Because the outcomes do not vary substantially across specification variants employing a time trend, year indicators, state-specific linear time trend, and year indicators with state-specific linear time trend, we display the results only for the variant that includes a linear time trend. The coefficients on the social capital variables are negative and significant in the equations representing non-speeding-related crashes, but not significant in the equations representing speeding-related crashes. Our t-test results comparing the coefficients between the speeding- and non-speeding-related equations indicate that social capital's protective effect is significantly stronger for non-speeding-related crashes. Meanwhile, the coefficients on the social capital variables are negative and significant both in the equations representing non-alcohol-related crashes and those representing alcohol-related crashes. Our t-test results comparing the coefficients across equations indicate no significant difference between social capital's protective effect in these two classes of crashes. Finally, the coefficients on the social capital variables are negative and significant in the equations representing fatalities of non-seatbelt users, but not significant in the equations representing the fatalities of seatbelt users. Our t-test results comparing the coefficients between the seatbelt-use and seatbelt-nonuse equations indicate that social capital's protective effect with respect to fatalities is significantly stronger for crashes involving seatbelt-nonuse by the fatally injured person.

< PLACE TABLE 9 APPROXIMATELY HERE >

DISCUSSION

Nagler [2013a] established that social capital improves traffic safety. A causal relationship was shown to hold across several different measures of social capital and a range of highway safety outcomes. A follow-on study indicated that pro-social behaviors are at the heart of the explanation of why geographies with greater social capital also have better traffic safety outcomes [Nagler 2013b]. With those studies as a backdrop, the present analysis has examined the relative social capital levels and traffic safety outcomes of urban and rural environments in order to identify the specific implications of social capital's protective effect for the rural context.

The results in Table 5 indicate that social capital is not significantly greater in states that are more rural based on our measures. To the extent that this indicates that social capital is no greater in rural than urban areas (see limitations discussion below), it is indeed surprising: rural areas, being isolated with lower population densities, are perceived to be characterized by stronger social ties resulting from denser familial links between members of the community [Weisheit et al. 2006].

Not only was social capital not significantly greater in states with greater measures of rural-ness; there was also no evidence that social capital significantly influences traffic safety on rural-classified roads. This result obtained despite our corresponding observation that social capital has a substantial influence on the incidence of fatalities in urban-classified motor vehicle crashes. One logical explanation would be that certain factors peculiar to rural traffic safety problems or situations are intractable to social capital. That is, while pro-social behavior by motorists can save lives, there is something causing people to die on rural roads that pro-social behavior cannot effectively address.

To consider this possibility, we investigated the role of crash type and context in determining social capital's differential effects between rural and urban environments. The expectation was that differences in crash-type or crash-context exposure, entailing different levels of driver interaction in crash situations on average between rural and urban road environments, would explain the urban-rural differential. This would be reflected in an elimination of the differential once the crash type or context was statistically controlled-for. Such an outcome would be consistent with Nagler's [2013b] finding that social capital has significantly greater lifesaving effects where driver interaction plays a role. However, when we consider the effect of social capital on fatality risk restricted to multi-vehicle and junction-related crashes (i.e., those that involve driver interactions), the gulf between rural- and urban-classified roads remains (Tables 7 and 8). This suggests there is more to the rural-urban differential than the relative dearth on rural roads of traffic situations in which pro-social interaction could have beneficial impacts.

We turned next to the possible mediating roles of behavioral risk factors. We considered speeding and seatbelt non-use, both of which were found to have a greater likelihood of occurrence in rural than urban fatal incidents (see Table 4); and also alcohol use, which was found to be more common as a risk factor in urban incidents. While the results here are mixed, they provide some indication that the differential effect of social capital on rural and urban traffic fatalities can potentially be explained by such factors. Specifically, we find that social capital has no significant effect in speeding-related crashes, but it does have an effect in non-speeding-related crashes. Given that speeding-related crashes represent a greater share of the fatal crashes on rural than urban roads, it is possible that the rural-urban differential in social capital effects stems in some measure from the involvement in speeding-related crash situations of critical safety factors orthogonal to the effects of social capital. That is, whereas social capital can help with crashes where the factors most important to a safe outcome relate to interaction and coordination among drivers (e.g., incidents involving traffic signals, yields, merges, etc.), it has nothing to do with whether people die in crashes in which someone independently decides to drive too fast. In such situations, we would suggest, outcomes likely depend upon factors such as road conditions (hence the ease of braking) that social capital cannot influence.

Despite the complete absence of statistically significant positive effects, it would not be correct to say that social capital provides no benefits in terms of rural traffic safety. Table 9 shows that social capital has a greater life-saving effect as measured by the rate of fatalities in incidents in which one or more of the fatally injured persons were *not* wearing seatbelts as compared to fatalities in incidents in which all *were* wearing seatbelts. While by no means conclusive evidence of such an effect, the findings are consistent with the possibility that social capital increases seatbelt use. A social capital-induced movement of individuals from "non-seatbelt-wearing" to "seatbelt-wearing" would imply, all else equal, a decrease in *all* classes of incidents characterized by non-seatbelt-wearing, coinciding with an increase, all else equal, in all classes of incidents characterized by seatbelt wearing. If social capital reduces traffic fatalities on average across all incidents, then its effect on seatbelt use would be expected to manifest, in net, in a greater reduction in fatalities among non-seatbelt-wearers and a reduced or eliminated reduction in fatalities among seatbelt wearers. This is what we observe in our results. Such a behavioral trend, if real and if truly present across both rural and urban driving environments, implies real social capital benefits in terms of rural traffic safety.[13]

Limitations and future work

There is still much left unresolved. Given the significance of rural traffic safety as a public health issue, it is unfortunate that the "current knowledge and expertise about how to improve rural road safety is not sufficient" and that there is "insufficient information available on rural road safety problems to adequately support appropriate policy and investment decisions" [OECD 1999]. In particular, while the present study contributes a new perspective on rural traffic safety in light of the role of social capital, the limitations of our study must be appropriately recognized, and more work must be done to realize the full potential of our findings.

Caution should be taken in interpreting our surprising finding that social capital is no greater in rural than urban areas. In particular, three methodological limitations might explain

[13] In a separate regression (not shown), we find that the significant differential in the life-saving effects of social capital between seatbelt nonusers and seatbelt users exists *within* both rural and urban environments. This finding more directly supports the notion that social capital increases seatbelt use on rural roads (and, distinctly, on urban roads as well).

our null results. First, both the measures of social capital and the proxy-measures of the quality of "rural-ness" that we used in the analysis were aggregated at the state level. This may be too high a level of aggregation: though one state may be "more rural" than another based on our metrics, many states comprise both urban and rural areas such that, focusing at the state level, we may have lost information about the behavior and attitudes within localized areas necessary to isolate the hypothesized effect. Ideally, and in future analysis, both social capital and rural-ness data should be collected at a smaller level of aggregation, such as county or municipality, allowing the cleaner isolation of rural areas and their associated attributes. A second issue is that the proxy-measures of state-level rural-ness may not have been valid indicators of rural environments. For example, a state might have a capital city with a large population but still be largely rural. Finally, as our analysis is based on a simple bivariate correlation, we have not controlled for mediating or moderating factors that might play a role in the relationship of social capital to rural-ness. In view of the methodological limitations of our exploratory analysis, the results we obtained should be considered tentative and preliminary.[14]

Methodological issues might also be responsible for our finding that social capital has a significant protective effect on urban roads but no such effect on rural roads. One possibility is that differential snow-induced selection into light trucks across rural and urban areas is responsible for the observed outcome. It may be, for example, that snow removal is inferior in rural relative to urban areas; this would be expected to induce more rural drivers to select light trucks, resulting in turn in increased fatalities on rural roads in the summer.[15] Thus the snow-depth-instrumented protective effect of social capital observed on rural roads might be reduced

[14] A fourth possible objection – that social capital as measured reflects an urban bias (that is, that our measures are indicating higher levels of social capital for urban respondents, independent of the true fundamentals) – is mitigated by the demonstrated robustness of our results to the use of two alternative measures of social capital.

[15] Gayer [2004] showed that the presence of sport-utility vehicles and other light trucks on the road is associated with a greater rate of crashes and a greater rate of fatality in crashes.

relative to the protective effect observed on urban roads. While this possibility remains a potential challenge to our results, we believe the problem is limited by the occurrence of extensive, fad-oriented adoption of light trucks in suburban and urban areas during our sample period.

Another possibility is that social capital's lack of effect is attributable to rural driving being less social and interactive by nature than urban driving, despite this effect not being reflected in the incident-type dichotomies we examined. Thus, for example, even within the limiting set of multi-vehicle crashes, the rural incident subset might have involved fewer opportunities for pro-social behavior to play a role than the urban incident subset. This might be due to factors that we have not accounted for, such as road type, or the interaction of number of vehicles involved with the relation of the incident to a junction location.

Further research is needed to investigate the reason for the difference we have observed between social capital's influence in rural and urban traffic incidents. While we have shown that social capital is unhelpful with respect to safety in situations involving speeding – situations that are relatively more common in rural areas – it would probably be a stretch to say that the intractability of such situations fully explains the overall failure of social capital to save lives on rural roads.[16] One alternative possibility is that social capital is less helpful in preventing deadly crashes on rural roads because of the greater salience of a contradictory rural traffic safety culture. Traffic safety culture can be described as the values, beliefs and attitudes that a group shares (i.e., as a social norm) about the importance of traffic safety and behaviors affecting it [Ward 2007; Ward et al. 2010]. The traffic safety culture prevalent in rural areas takes a fatalistic and denial-oriented perspective on risks [Rakauskas et al. 2009; Coogan et al. 2010] and so de-

[16] We note, in particular, that while the risk ratio for speeding in rural states relative to urban states is *significantly* greater than unity, it is only 1.05, so not much greater than unity in *magnitude*.

emphasizes taking care to protect others on the road. It might, therefore, pre-empt the tendencies people have to act in the interests of others in the community that they normally exhibit when not behind the wheel. In urban areas, meanwhile, where the prevalent traffic safety culture subsumes less fatalism and denial, the group-protective tendencies fostered by social capital would be paramount for urban drivers. On these points we can merely speculate; more formal investigation is needed. Other factors that might explain the differential effect of social capital on rural and urban roads, and that invite further investigation, include differences in vehicle type and in relevant demographic characteristics of the drivers, such as education level [Ward 2007].

Finally, while our state-level analysis of the differential effects of social capital across rural and urban road environments has provided robust and potentially useful findings, it should not be considered the "final word" in this line of research in view of the limitations discussed above with respect to measuring social capital at the state level. County-level analysis of social capital's traffic safety influences offers a logical next step.

CONCLUSIONS

This study has shed some light on the role of social capital in rural traffic safety. We have found that social capital has a significantly greater protective effect with respect to crash outcomes on urban roads than on rural roads. Part of the explanation for this appears to lie in the possibility that social capital is unhelpful in incidents involving speeding (a more common factor in rural crash fatalities), whereas it is helpful in non-speeding-related incidents (more common in urban areas).[17] More generally, various risky driver behaviors and other risk correlates more

[17] See footnote 16 above.

common in rural than urban environments might precipitate traffic situations in which the critical safety factors are orthogonal to social capital.

Though this study has left some key questions unanswered, an important public policy implication emerges. Public policy efforts targeted at urban areas might effectively attempt to foster the formation of social capital to improve traffic safety outcomes, as well as other public health outcomes that have been shown to depend on social capital [Kawachi et al. 2004]. Meanwhile, in view of the limited impact of social capital in rural traffic incidents, policy efforts for traffic safety in such areas would best be targeted directly at improvement of observed behavioral problems, such as speeding, rather than social capital formation.

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References

Andridge, Rebecca R., and Roderick J. A. Little. 2010. A Review of Hot Deck Imputation for Survey Non-response. *International Statistical Review,* 78(1): 40-64.

Bishai, David, Asma Quresh, Prashant James, and Abdul Ghaffar. 2006. National Road Casualties and Economic Development. *Health Economics,* 15(1): 65-81.

Bowles, Samuel, and Herbert Gintis. 1998. The Moral Economy of Communities: Structured Populations and the Evolution of Pro-social Norms. *Evolution and Human Behavior,* 19(1): 3-25.

Coogan, Matthew, Sonja Forward, Jean-Pascal Assailly, and Thomas Adler. 2010. Urban and Rural Differences in Attitudes Related to Risky Driving Behaviors: The Role of Sensation Seeking and Risk Perception, in *Conference proceedings of the International Association of Applied Psychology, Traffic Psychology Division*, Melbourne, Australia.

Eiksund, Sveinung. 2009. A Geographical Perspective on Driving Attitudes and Behaviors Among Young Adults in Urban and Rural Norway. *Safety Science,* 47(4): 529-536.

Gayer, Ted. 2004. The Fatality Risks of Sport-utility Vehicles, Vans, and Pickups Relative to Cars. *Journal of Risk and Uncertainty,* 28(2): 103-133.

Grootaert, Christiaan, Gi-Taik Oh, and Anand Swamy. 2002. Social Capital, Household Welfare and Poverty in Burkina Faso. *Journal of African Economies*, 11(1), 4-38.

Hanson, Dale, Jan Hanson, Paul Vardon, Kathryn McFarlane, Rick Speare, and David Durrheim. 2008. Documenting the Development of Social Capital in a Community Safety Promotion Network: It's Not What You Know But Who You Know. *Health Promotion Journal of Australia,* 19(2), 144-151.

Harpham, Trudy, Emma Grant, and Carlos Rodriguez. 2004. Mental Health and Social Capital in Cali, Colombia. *Social Science & Medicine*, 58(11), 2267-2277.

Hawes, Daniel, Rene Rocha, and Kenneth Meier. 2012. Social Capital in the 50 States: Measuring State-level Social Capital, 1986-2004. *State Politics & Policy Quarterly,* 13(1), 121-138.

Helliwell, John F., and Shun Wang. 2011. Trust and Well-being. *International Journal of Well-Being,* 1(1), 42-78.

Karlan, Dean, Marius Mobius, Tanya Rosenblat, and Adam Szeidl. 2009. Trust and Social Collateral. *Quarterly Journal of Economics*, 124(3), 1307-1361.

Kawachi, Ichiro, Daniel Kim, Adam Coutts, and S.V. Subramanian. 2004. Commentary: Reconciling the Three Accounts of Social Capital. *International Journal of Epidemiology*, 33(4), 682-690.

Keele, Luke. 2007. Social Capital and the Dynamics of Trust in Government. *American Journal of Political Science,* 51(2), 241-254.

Keeler, Theodore E. 1994. Highway Safety, Economic Behavior, and Driving Environment. *American Economic Review*, 84(3), 684-693.

Kennedy, Peter. 2008. *A Guide to Econometrics,* 6th ed. Malden, MA: Blackwell.

Knack, Stephen. 2001. Trust, Associational Life, and Economic Performance, in *The Contribution of Human and Social Capital to Sustained Economic Growth and Well-Being, Proceedings of OECD/HRDC Conference, Quebec, 19-21 March 2000*, edited by John F. Helliwell. Ottawa: HRDC.

Kopits, Elizabeth, and Maureen Cropper. 2005. Traffic Fatalities and Economic Growth. *Accident Analysis and Prevention*, 37(1), 169-178.

Lynch, John W., and George A. Kaplan. 1997. Understanding How Inequality in the Distribution of Income Affects Health. *Journal of Health Psychology*, 2(3), 297-314.

Nagler, Matthew G. 2013a. Does Social Capital Promote Safety on the Roads? *Economic Inquiry,* 51(2), 1218-1231.

__________. 2013b. Playing Well with Others: The Role of Social Capital in Traffic Accident Prevention. *Eastern Economic Journal,* 39(2), 172-200.

Narayan, Deepa , and Lant Pritchett. 1999. Cents and Sociability: Household Income and Social Capital in Rural Tanzania. *Economic Development and Cultural Change,* 47(4), 871-897.

NHTSA. 1996. *Rural and Urban Crashes: A Comparative Analysis*. Research Note. Washington, DC: USDOT.

NHTSA. 2012. *Rural/Urban comparison.* DOT HS 811637. Washington, DC: USDOT.

Organisation for Economic Co-operation and Development (OECD). 1999. *Safety Strategies for Rural Roads.* IRRD No. 491006. Paris: OECD Publishing.

Putnam, Robert D. 2000. *Bowling Alone: The Collapse and Revival of American Community*. New York: Simon & Schuster.

Rakauskas, Michael E., Nicholas J. Ward, and Susan G. Gerberich. 2009. Identification of Differences between Rural and Urban Safety Cultures. *Accident Analysis and Prevention,* 41(5), 931-937.

Ward, Nicholas J. 2007. *The Culture of Traffic Safety in Rural America*. AAA Foundation for Traffic Safety, http://fondzebra.ru/files/library/books/143_Improving_Traffic_Safety_Culture_in_the_United_States/Improving_Traffic_Safety_Culture_in_the_United_States_EN.pdf#page=251, 241-256.

Ward, Nicholas J., Jeff Linkenback, Sarah N. Keller, Jay Otto. 2010. White Paper on Traffic Safety Culture. Western Transportation Institute, #2. http://safety.transportation.org/doc/web2%20Safety%20Culture%20White%20Paper.pdf.

Weisheit, Ralph A., David N. Falcone, and L. Edward Wells. 2006. *Crime and Policing in Rural and Small-town America*, 3rd ed. Long Grove, IL Waveland Press Inc.

Williams, Dmitri. 2006. On and Off the 'Net: Scales for Social Capital in an Online Era. *Journal of Computer-Mediated Communication,* 11(2), 593-628.

Zak, Paul J., and Stephen Knack. 2001. Trust and Growth. *Economic Journal*, 111(470), 295-321.

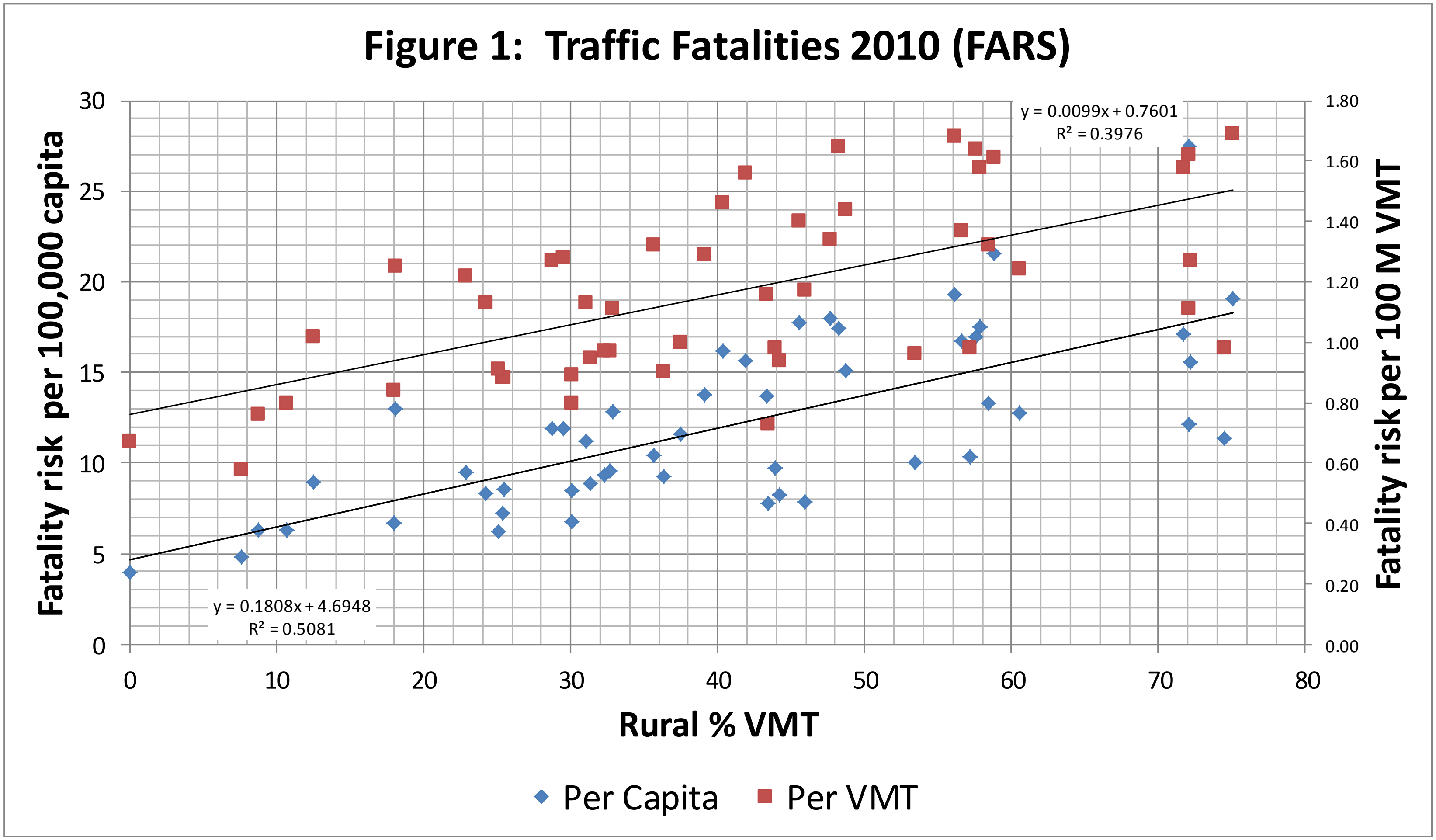

Figure 1: Traffic Fatalities 2010 (FARS)
Fatality risk per 100,000 capita
Fatality risk per 100 M VMT
Rural % VMT
y = 0.0099x + 0.7601
R² = 0.3976
y = 0.1808x + 4.6948
R² = 0.5081
Per Capita
Per VMT
0
5
10
15
20
25
30
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
0
10
20
30
40
50
60
70
80

Table 1 Low-count states for "most people are honest" variable

Low-count state	*Used for Imputation*
Delaware	Maryland
North Dakota	Montana
Vermont	New Hampshire
Wyoming	Montana

Table 2 Highest and lowest states for social capital, based on average over years in study (1997-2006)

	Voter turnout (%)			Agree "most people are honest" (6-point scale)	
	State	*10-year avg.*		*State*	*10-year avg.*
Highest					
1	Minnesota	67.7%	1	Minnesota	3.809
2	Maine	60.8%	2	South Dakota	3.762
3	South Dakota	59.3%	3	Wisconsin	3.737
Lowest					
46	Texas	41.4%	46	Georgia	3.385
47	Mississippi	40.4%	47	Arizona	3.378
48	West Virginia	39.6%	48	Mississippi	3.325

Table 3 Summary Statistics - Traffic Fatality and Social Capital Variables (N=480)

Variable	Mean	St. Dev.	Min.	Max	No. of Zero Values
Summer traffic fatalities					
on rural roads					
total	147.08	113.15	1	591	0
in multi-vehicle crashes	64.08	52.12	1	269	0
in single-vehicle crashes	83.01	62.91	0	343	1
in junction-related crashes	30.33	24.45	0	129	6
in non-junction-related crashes	116.75	92.34	0	498	2
on urban roads					
total	92.94	114.79	0	679	1
in multi-vehicle crashes	43.09	52.14	0	295	12
in single-vehicle crashes	49.85	63.70	0	409	6
in junction-related crashes	35.87	42.87	0	246	10
in non-junction-related crashes	57.08	73.46	0	478	6
in speeding-related crashes	74.05	75.74	3	413	0
in non-speeding related crashes	165.98	148.05	8	832	0
in alcohol-related crashes	97.27	93.04	5	530	0
in non-alcohol related crashes	142.76	125.03	9	722	0
involving seatbelt non-use	95.21	76.91	3	454	0
involving seatbelt use	144.82	147.53	7	981	0
Social capital					
Voter turnout	0.50	0.67	0.36	0.71	NA
"Most people are honest" (6-level agree scale)	3.56	0.19	2.84	4.16	NA

Notes: Observations in the panel data set consist of a given state in a given year between 1997 and 2006.

Table 4 Fatality Counts and Risk Ratios Associated with Behavioral Risk Factors, Rural- vs. Urban-Classified Roads, 1997 - 2006

	(1)	(2)
	Factor Present	Factor Absent
Alcohol		
Rural	27,608	42,992
Urban	19,042	25,469
RR=.91; Significant at 1% level		
Speeding		
Rural	22,156	48,444
Urban	13,359	31,152
RR=1.05; Significant at 1% level		
Seatbelt Non-use		
Rural	31,888	38,712
Urban	13,757	30,754
RR=1.46; Significant at 1% level		

Notes: Risk ratios show how many more times likely the relevant risk factor is of having played a role in the fatality on rural roads relative to urban roads. Calculation: RR=$[a/(a+b)]/[c/(c+d)]$, where a=rural incidence of fatality with risk factor present, b=rural incidence of fatality with risk factor absent, c=urban incidence of fatality with risk factor present, d=urban incidence of fatality with risk factor absent.

Table 5 Correlation of Social Capital Measures with Proxy-measures of "Rural-ness"

	Social capital - agree "most people are honest" (2006)	Percentage of Population Living in Rural Areas[1]	Population of Capital City[2]	Percentage of Total Road Mileage Classified as Rural[3]	Percentage of Vehicle Miles Traveled on Rural-Classified Roads[4]
Social capital - voter turnout (2006)	0.359***	0.107	-0.278**	0.073	0.176
Social capital - agree "most people are honest" (2006)	--	-0.031	0.012	0.147	0.077

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

Notes:

[a]Estimated using 2000 and 2010 census data and assuming linear trend of change.

[b]United States Census Bureau. City and Town Intercensal Estimates (2000-2010).

[c]Federal Highway Administration - U.S. Department of Transportation. Public Road Length by Functional System, 1980 – 2007.

[d]Federal Highway Administration - U.S. Department of Transportation. Annual Vehicle - Miles of Travel, 1980 – 2007.

Table 6 3SLS: Effect of Social Capital - Fatalities on Rural- vs. Urban-Classified Roads

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Equation 1: fatalities on urban roads								
Social capital (voter turnout)	-5.087***	-5.302***	-2.173*	-4.069***				
	(0.826)	(0.817)	(1.236)	(1.359)				
Social capital (agree "most people are honest")					-3.137***	-2.939***	-2.103***	-1.686***
					(0.630)	(0.531)	(0.744)	(0.582)
R-squared	0.8625	0.8636	0.9201	0.9207	0.7895	0.8125	0.9025	0.9153
Equation 2: fatalities on rural roads								
Social capital (voter turnout)	-0.252	-0.242	0.159	0.269				
	(0.592)	(0.586)	(0.733)	(0.726)				
Social capital (agree "most people are honest")					-0.155	-0.134	0.164	0.112
					(0.366)	(0.326)	(0.388)	(0.302)
R-squared	0.8591	0.8602	0.9540	0.9550	0.8583	0.8595	0.9527	0.9545
Equality of coefficients?	R: 1%	R: 1%	FTR	R: 1%	R: 1%	R: 1%	R: 5%	R: 5%
Equation 3: social capital								
Average daily snow depth	0.018***	0.018***	0.011***	0.012***	0.029***	0.033***	0.021***	0.029***
	(0.0012)	(0.0012)	(0.0010)	(0.0010)	(0.005)	(0.004)	(0.005)	(0.005)
R-squared	0.6004	0.6091	0.8526	0.8690	0.3171	0.3948	0.5671	0.6356
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: The dependent variable in Equation 1 consists of the normalized natural log of traffic fatalities occurring on urban-classified roads during the months of June, July, and August. The dependent variable in Equation 2 is analogous, but pertains to rural-classified roads. The dependent variable in Equation 3 is the turnout rate of the voting eligible population for the highest office election for the year (columns 1-4) or a variable representing level of agreement with "most people are honest" (columns 5-8) . Each equation 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. N=480 for all models. "Equality of coefficients?" reports results of the chi-square test for equality of the social capital coefficients in Equations 1 and 2 (R=reject, FTR=fail to reject), with critical level for rejections (1, 5 or 10%).

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

Table 7 3SLS: Effect of Social Capital - Fatalities on Rural- vs. Urban-Classified Roads Accounting for Crash Type

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Equation 1: multi-vehicle crash fatalities on urban roads								
Social capital (voter turnout)	-6.491***	-6.672***	-5.452***	-7.451***				
	(1.022)	(1.011)	(1.648)	(1.847)				
Social capital (agree "most people are honest")					-4.002***	-3.698***	-4.000***	-3.088***
					(0.802)	(0.668)	(1.113)	(0.841)
R-squared	0.8077	0.8092	0.8672	0.8663	0.6885	0.7286	0.7881	0.8388
Equation 2: multi-vehicle crash fatalities on rural roads								
Social capital (voter turnout)	-0.686	-0.662	-1.144	-0.228				
	(0.681)	(0.674)	(0.895)	(0.971)				
Social capital (agree "most people are honest")					-0.423	-0.367	0.244	-0.095
					(0.427)	(0.378)	(0.505)	(0.402)
R-squared	0.8368	0.8385	0.9276	0.9295	0.8317	0.8346	0.9246	0.9296
Equality of coefficients?	R: 1%	R: 1%	R: 5%	R: 1%	R: 1%	R: 1%	R: 1%	R: 1%
Equation 3: single-vehicle crash fatalities on urban roads								
Social capital (voter turnout)	-4.700***	-4.967***	-0.601	-2.973**				
	(0.884)	(0.875)	(1.395)	(1.514)				
Social capital (agree "most people are honest")					-2.898***	-2.753***	-1.594**	-1.232**
					(0.630)	(0.537)	(0.791)	(0.628)
R-squared	0.8513	0.8528	0.9048	0.9074	0.8019	0.8193	0.8987	0.9073
Equation 4: single-vehicle crash fatalities on rural roads								
Social capital (voter turnout)	-0.131	-0.104	-0.139	0.265				
	(0.652)	(0.646)	(0.814)	(0.815)				
Social capital (agree "most people are honest")					-0.081	-0.058	0.236	0.110
					(0.403)	(0.358)	(0.431)	(0.339)
R-squared	0.8294	0.8303	0.9426	0.9434	0.8290	0.8300	0.9403	0.9431
Equality of coefficients?	R: 1%	R: 1%	FTR	R: 10%	R: 1%	R: 1%	R: 10%	R: 10%
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: The dependent variable in Equation 1 (Equation 3) consists of the normalized natural log of multi-vehicle (single-vehicle) crash fatalities occurring on urban-classified roads during the months of June, July, and August. The dependent variable in Equation 2 (Equation 4) is analogous, but pertains to rural-classified roads. The dependent variable in Equation 5 (for which results are identical to those for Equation 3 in Table 6, therefore not shown) is the turnout rate of the voting eligible population for the highest office election for the year (columns 1-4) or a variable representing level of agreement with "most people are honest" (columns 5-8). Each equation 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. N=480 for all models. "Equality of coefficients?" reports results of the chi-square test for equality of the social capital coefficients in Equations 1 and 2, and Equations 3 and 4, respectively (R=reject, FTR=fail to reject), with critical level for rejections (1, 5 or 10%).
***Significant at 1% level **Significant at 5% level

Table 8 3SLS: Effect of Social Capital - Fatalities on Rural- vs. Urban-Classified Roads Accounting for Crash Context

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Equation 1: junction-related crash fatalities on urban roads								
Social capital (voter turnout)	-5.297***	-5.658***	-1.438	-4.068**				
	(0.981)	(0.972)	(1.541)	(1.688)				
Social capital (agree "most people are honest")					-3.266***	-3.136***	-2.024**	-1.686**
					(0.711)	(0.614)	(0.881)	(0.705)
R-squared	0.8104	0.8116	0.8793	0.8806	0.7378	0.7554	0.8694	0.8788
Equation 2: junction-related crash fatalities on rural roads								
Social capital (voter turnout)	0.616	0.676	-0.254	0.530				
	(0.935)	(0.927)	(1.399)	(1.533)				
Social capital (agree "most people are honest")					-0.380	0.374	0.430	0.220
					(0.577)	(0.515)	(0.784)	(0.637)
R-squared	0.7505	0.7514	0.8561	0.8571	0.7495	0.7506	0.8529	0.8563
Equality of coefficients?	R: 1%	R: 1%	FTR	R: 10%	R: 1%	R: 1%	R: 10%	R: 10%
Equation 3: non-junction-related crash fatalities on urban roads								
Social capital (voter turnout)	-5.208***	-5.368***	-2.712*	-4.491***				
	(0.935)	(0.924)	(1.458)	(1.605)				
Social capital (agree "most people are honest")					-3.211***	-2.975***	-2.410***	-1.861***
					(0.683)	(0.575)	(0.882)	(0.685)
R-squared	0.8449	0.8466	0.9019	0.9028	0.7823	0.8064	0.8792	0.8969
Equation 4: non-junction-related crash fatalities on rural roads								
Social capital (voter turnout)	-0.380	-0.370	0.090	0.223				
	(0.635)	(0.629)	(0.773)	(0.766)				
Social capital (agree "most people are honest")					-0.234	-0.205	0.152	0.093
					(0.394)	(0.350)	(0.408)	(0.318)
R-squared	0.8421	0.8433	0.9501	0.9512	0.8403	0.8417	0.9491	0.9509
Equality of coefficients?	R: 1%	R: 1%	FTR	R: 5%	R: 1%	R: 1%	R: 5%	R: 5%
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: The dependent variable in Equation 1 (Equation 3) consists of the normalized natural log of junction-related (non-junction-related) crash fatalities occurring on urban-classified roads during the months of June, July, and August. The dependent variable in Equation 2 (Equation 4) is analogous, but pertains to rural-classified roads. The dependent variable in Equation 5 (for which results are identical to those for Equation 3 in Table 6, therefore not shown) is the turnout rate of the voting eligible population for the highest office election for the year (columns 1-4) or a variable representing level of agreement with "most people are honest" (columns 5-8). Each equation 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. N=480 for all models. "Equality of coefficients?" reports results of the chi-square test for equality of the social capital coefficients in Equations 1 and 2, and Equations 3 and 4, respectively (R=reject, FTR=fail to reject), with critical level for rejections (1, 5 or 10%).

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

Table 9 3SLS: Effect of Social Capital on Fatalities Accounting for Behavioral Risk Factors

	(1)	(2)	(3)	(4)	(5)	(6)
Risk Behavior	Speeding	Alcohol	Seatbelt Non-use	Speeding	Alcohol	Seatbelt Non-use
Equation 1: fatalities with factor absent						
Social capital (voter turnout)	-2.342***	-1.458***	-0.570			
	(0.403)	(0.341)	(0.365)			
Social capital (agree "most people are honest")				-1.444***	-0.899***	-0.352
				(0.315)	(0.242)	(0.225)
R-squared	0.9304	0.9476	0.9450	0.8883	0.9308	0.9449
Equation 2: fatalities with factor present						
Social capital (voter turnout)	0.189	-1.913***	-3.381***			
	(0.719)	(0.433)	(0.447)			
Social capital (agree "most people are honest")				0.117	-1.180***	-2.085***
				(0.445)	(0.283)	(0.379)
R-squared	0.7842	0.9144	0.9010	0.7819	0.9035	0.8127
Equality of coefficients?	R: 1%	FTR	R: 1%	R: 5%	FTR	R: 1%

Notes: The dependent variable in Equation 1 consists of the normalized natural log of traffic fatalities during the months of June, July, and August, in crashes in which the indicated risk behavior was absent. The dependent variable in Equation 2 is analogous, but pertains to crashes in which the indicated risk behavior was present. The dependent variable in Equation 3 (for which results are identical to those for Equation 3 in Table 6, therefore not shown) is the turnout rate of the voting eligible population for the highest office election for the year (columns 1-3) or a social capital variable representing level of agreement with "most people are honest" (columns 4-6). Each equation incorporates a time trend, and each 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. N=480 for all models. "Equality of coefficients?" reports results of the chi-square test for equality of the social capital coefficients in Equations 1 and 2 (R=reject, FTR=fail to reject), with critical level for rejections (1, 5 or 10%).
***Significant at 1% level