Accident Analysis and Prevention 154 (2021) 106067

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

Democracy, governance, and road safety

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ARTICLE INFO

Keywords:
Democracy
Governance
Government effectiveness
Road safety

ABSTRACT

Countries scoring high on the Democracy Index developed by The Economist Intelligence Unit have fewer traffic fatalities per 100,000 inhabitants than countries scoring low on this index. The statistical relationship between democracy score and fatalities per 100,000 inhabitants is statistically highly significant and robust with respect to control for potentially confounding factors. A similar relationship exists between democracy score and the number of traffic fatalities per 100,000 motor vehicles. The statistical relationship between level of democracy and level of road safety is strong, although the analyses reported in this paper do not justify a causal interpretation of the relationship. Changes over time in government effectiveness (one of the indicators of the World Governance Index developed by the World Bank) are weakly associated with changes in road safety performance.

1. Introduction

A huge number of factors influence the number of road accidents. Some of these factors exert a similar influence in all countries. Higher speed increases the risk of accidents and their severity in all countries where studies have been reported (Elvik, 2005; Elvik et al., 2019). The effects of traffic volume on the number of accidents are similar across countries (Høye and Hesjevoll, 2020). Seat belts protect from injury everywhere (Høye, 2016).

Despite the similarity of the effects of these factors, the level of road safety, as indicated by the number of traffic fatalities per 100,000 inhabitants, varies greatly between countries. It is known that this variation is related to national income level (Kopits and Cropper, 2005). Most traffic fatalities today occur in low- and middle-income countries. These countries also have the highest rate of traffic fatalities, both per 100,000 inhabitants and per 100,000 motor vehicles. High-income countries have succeeded in reducing the number of traffic fatalities. The number remains stable or continues to grow in most low- or middle-income countries.

Smeed (1949) compared countries with respect to road safety as early as 1949. He found an inverse relationship between the number of motor vehicles per inhabitant and the number of fatalities per motor vehicle. This relationship was replicated in subsequent studies and became known as "Smeed's law".

The number of motor vehicles per inhabitant is related to income level. Less is known about the relationship between the political system of a country and its level of road safety. Acemoglu and Robinson (2012) show that countries that have what they refer to as "extractive institutions" tend to remain poor and fail to develop economically. Extractive institutions are usually a hallmark of authoritarian governments. If authoritarian political systems fail to bring about economic growth, maybe they also fail to improve road safety? The objective of this paper is to examine the relationship between democracy, governance and road safety. Is there a relationship between how democratic a country is and its level of road safety? The data used to answer this question are cross-sectional and do not lend themselves to causal interpretations. It will nevertheless be discussed whether it is reasonable to think that democracy is causally related to road safety.

2. Previous studies

A literature survey was conducted to identify previous studies of the relationship between democracy, governance and road safety. The survey used "democracy" AND "road safety" and "governance" AND "road safety" as search terms. A search was made of Google Scholar, Science direct and the TRID literature database. In Google Scholar there were about 9700 hits for democracy and road safety and about 19,500 for governance and road safety. The first 100 were screened for both combinations of search terms. In Science direct, there were 196 hits for democracy and road safety and 668 for governance and road safety. All were screened. TRID gave 12 hits for democracy and road safety and 59 for governance and road safety. All were screened. In all databases, relevant studies were identified based on their titles. Table 1 lists the studies that were reviewed.

Gaygisiz (2010) studied cultural values and governance quality as correlates of road traffic fatalities. The study included 46 countries, among them a few which would not be regarded as (full) democracies (e.g. China and Russia). Governance quality was measures by means of the world governance indictors developed by the World Bank (Kaufmann et al., 2010). There

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https://doi.org/10.1016/j.aap.2021.106067
Received 30 December 2020; Accepted 1 March 2021
Available online 7 March 2021

Table 1
Summary of previous studies of democracy, governance and road safety.

Study	Number of countries included	Indicators of democracy or governance	Confounding variables controlled for	Main findings
Gaygisiz (2010)	46	World governance indicators (WGI)	GDP per capita; Hofstede's cultural dimensions; Schwartz' value scores	WGI correlated negatively (-.41 to -.51) with fatalities per million vehicles
Law et al. (2011)	60	Political rights index (1−7); corruption index (0−6)	Nine variables; e.g. population, GDP per capita, infant mortality	More political rights positively associated with number of fatalities; more corruption positively associated with number of fatalities in rich countries
Sadullah et al. (2012)	13	Designation as "model jurisdiction" in road safety	None	The more designations as model jurisdiction, the larger the decline in fatalities from 1970 to 2008; weak relationship only
Mackenbach and McKee (2015)	30	Mean of two indicators of democracy; WGI voice and accountability index; share of women in Parliament	Several; e.g. political colour of government, quality of government, political stability, rule of law	Democracy and voice and accountability correlated negatively with traffic fatality rate; all indicators of government quality correlated negatively with traffic fatality rate (-.32 to -.89)
Tan et al. (2016)	176	World governance indicators (WGI)	None	Ln(fatalities/100,000 inhabitants) correlated negatively (-.58 to -.71) with WGI
Ücümcüoglu et al. 2018	37	Indicators of enforcement	Several; Hofstede's cultural dimensions; Schwartz' value scores, GDP per capita	All enforcement variables correlated negatively (-.37 to -.57) with fatalities per 100,000 inhabitants
Van den Berghe et al. (2020)	32	Public support for road safety measures	Hofstede's cultural dimensions; Schwartz' value scores	Stronger support for road safety measures in countries with high fatality rate

are six indicators and at least one (voice and accountability) is an indicator of how democratic a society is. All governance indicators correlated negatively with the number of traffic fatalities per capita. The more well-governed a country is, the lower is its traffic fatality rate.

Law, Noland and Evans (2011) studied sources of the Kuznets curve for traffic fatalities. This is the curve showing that the number of traffic fatalities increases as motorisation increases, reaches a peak and then starts to decline. The study included two indicators for democracy and governance: The Freedom House score for political rights, ranging from 1 (high freedom) to 7 (low freedom), and International Country Risk Guide score for corruption, ranging from 0 (lot of corruption) to 6 (little or no corruption). Somewhat surprisingly, the score for political rights was positively associated with the number of road accident fatalities, i.e. the more political rights, the higher the number of fatalities. Corruption, on the other hand, was detrimental to road safety in rich countries, but had a favourable effect on road safety in poor countries.

PIARC (Permanent International Association of Road Congresses) (Sadullah et al., 2012) conducted a comprehensive review of road safety policies in sample of countries, which were members of PIARC. Best practice policies were described. Countries conforming to best practice policies were designated as "model jurisdictions". For example, Sweden was designated as model jurisdiction 23 times, the United States 6 times, and Hungary a single time. Using these data, a relationship was found between the number of times a country was designated as a model jurisdiction and the decline in traffic fatality rate per capita from 1970 to 2008 (this relationship was not investigated by Sadullah et al., 2012). The Czech Republic was omitted as an outlier. It was found (by linear regression) that a country having one designation as model jurisdiction was estimated to reduce its per capita fatality rate by 63.3 % from 1970 to 2008. A country with 23 designations as model jurisdiction was estimated to reduce its per capita fatality rate by 76.4 % from 1970 to 2008. It should be noted, however, that only 13 countries were included and the regression explained only 9.8 % of the variation in the decline in fatality rate from 1970 to 2008.

Mackenbach and McKee (2015) studied factors influencing health policy in 30 European countries. The factors included a score for democracy, the voice and accountability scale of the world governance indicators, voter turnout in elections, and the share of women in the national assembly. Five indicators of quality of government were also included. One of the areas of health policy was motor vehicle accident mortality. Motor vehicle accident mortality correlated negatively with voice and accountability, and with all five indicators of quality of government. The study clearly indicated that a higher quality of governance, i. e. higher effectiveness of policy implementation, is associated with a higher level of road safety.

Tan et al. (2016) studied the correlation between the world governance indicators and the log of fatalities per 100,000 inhabitants in 176 countries. The data referred to 2013. Strong negative correlations (between -0.58 and -.71) were found, showing that countries scoring higher for governance have lower fatality rates. The study did not control for any confounding factors.

Üzümcüoglu et al. (2018) studied the relationship between cultural variables, law enforcement and driver behaviour in 37 countries. The study also included data on road accident fatalities per 100,000 inhabitants. Negative correlations were found between the perception of how effective five types of enforcement were in a country (0: not effective at all; 10: highly effective) and its fatality rate. The more effective enforcement is believed to be, the lower the fatality rate. This suggests that fatality rate is related to public perceptions of policy effectiveness.

Van den Berghe et al. (2020) investigated the association between national culture, support for road safety measures and road safety performance. 32 countries were included in the study of road safety performance. Public support for 15 different road safety measures was strongest in countries with a high fatality rate. This suggests that a high road accident fatality is not accepted as something inevitable, but that the public is willing to support measures to reduce fatalities. This, of course, assumes that reliable information on the number of traffic fatalities is available to the public, which may not necessarily be the case in authoritarian regimes. Nearly all of the countries studied by Van den Berghe et al. are rated as democracies according to the Democracy Index of The Economist Intelligence Unit.

In summary, these studies show that road safety is better in democratic countries, with an effective government. However, only one of the studies included countries from all over the world, but that study (Tan et al., 2016) did not control for any confounding factors. In the other studies, most of the countries included were high-income democracies. Different indicators of democracy and governance were used in different studies, some of them rather crude (e.g. the seven point scale used by Law et al.). No study used the Democracy Index developed by The Economist Intelligence Unit. Hence, by including more countries, particularly countries scoring low for democracy, and by using more recent data, more updated knowledge can be obtained about the relationship between democracy, governance, and road safety.

3. Sources of data

The main source of data about traffic fatalities, population, and the number of motor vehicles is the Global status report on road safety 2018, published by the World Health Organization (2018a). This report gives data for 2016 for all countries in the world. The report has estimated the true number of road accident fatalities for each country to account for incomplete reporting. In addition to data on the number of fatalities, population and the number of motor vehicles, the report states for each country whether it has implemented legislation to regulate seven risk factors contributing to road accidents. These are: speed, drinking and driving, motorcycle helmets, seat belts, child restraints, use of mobile phones while driving and use of drugs while driving. A score for road safety legislation ranging from 0/7 to 7/7 was given to each country, depending on how many of the risk factor were regulated by legislation. The following variables were extracted from the Global status report on road safety:

1 Number of fatalities per 100,000 inhabitants.
2 Number of fatalities per 100,000 motor vehicles.
3 Number of motor vehicles per 1000 inhabitants.
4 Score for road safety legislation (range 0/7 to 7/7).

For countries monitored by the European Transport Safety Council, data for 2019 were extracted from the 2020-PIN report (European Transport Safety Council, 2020). More recent data than 2016 were also obtained for Australia, Canada and the United States of America.

Data on alcohol consumption per inhabitant were taken from the Global status report on alcohol and health, published by the World Health Organization (2018b). These data refer to 2016 for all countries.

Viscusi and Masterman (2017) provide estimates of the value of a statistical life for (nearly) all countries of the world. The value of a statistical life is the monetary value of a risk reduction which is statistically identical to the prevention of one death. Viscusi and Masterman estimated the value of a statistical life for a given country by means of the following value transfer function:

$$VSL_c = VSL_{us} \cdot \left(\frac{Y_c}{Y_{us}}\right)^{\eta} \quad (1)$$

VSL_c is the value of a statistical life in country c. VSL_{us} is the value of a statistical life in the United States. Y_c is the per capita income in country c, Y_{us} is the per capita income in the United States, and η is the estimate of the elasticity of the value of a statistical life with respect to per capita income. Viscusi and Masterman use an elasticity of 1. This means that the value of a statistical life becomes proportional to per capita income and can serve as an indicator of per capita income. The values are in US dollars and refer to 2015.

Democracy was measured by means of the 2019-value of the democracy index for each country (The Economist Intelligence Unit, 2020). The democracy index developed by The Economist Intelligence Unit varies from 0 to 10 and is given by two decimals, (e.g. 9.87 for Norway in 2019). It is based on 60 indicators comprising electoral process and pluralism (multi-party system), functioning of government, political participation, democratic political culture and civil liberties. In addition to the democracy index, one of the world governance indicators developed by the World Bank was used (Kaufmann et al., 2010). That was the index for government effectiveness, which captures the quality of the civil service, its independence from political pressures and the quality of policy formulation and implementation. This is a standardised variable, with a mean of 0, standard deviation of 1, and range from (about) -2.5 to + 2.5.

A country was included in the study if: (1) Its score on The Democracy Index was known; (2) Fatalities per 100,000 inhabitants and per 100,000 motor vehicles were known; (3) The annual count of fatalities was more than about 25. The latter criterion excluded some small countries, like Iceland, Liechtenstein and San Marino. 148 countries were included.

Table 2 gives descriptive statistics for all variables included in the study. The variables form three groups: (1) Dependent variables. These include fatalities per 100,000 inhabitants, fatalities per 100,000 motor vehicles and the natural logarithms of these variables. (2) Independent variables. These include democracy score, government effectiveness score and score for legal regulation of risk factors. (3) Confounding variables. These include all other variables listed in Table 2.

The number of fatalities per 100,000 inhabitants ranges from 2.0 to 35.9, with a mean of 16.6. The number of fatalities per 100,000 motor vehicles varies from 2.6 to 4122.7, with a mean of 334. The democracy index, the independent variable of principal interest in this study, has a mean of 5.72, a minimum of 1.50 and a maximum of 9.87. The full data set is found in Appendix Table A1.

4. Statistical analysis

The association between democracy score and road accident fatality rate was examined by plotting the variables in a scatterplot. Fig. 1 shows the bivariate relationship between democracy score and the number of fatalities per 100,000 inhabitants.

There is a negative relationship between the variables: the higher the democracy score, the lower the number of fatalities per 100,000 inhabitants. There is no indication of non-linearity in the relationship. Exploratory analysis found that using the number of fatalities per 100,000 inhabitants as dependent variable in a linear regression model resulted in negative estimates of the fatality rate, which is impossible. The number of fatalities per 100,000 inhabitants was therefore transformed to its natural logarithm. This ensures that all predicted values are positive. The same transformation was applied to the number of fatalities per 100,000 motor vehicles.

Fig. 2 shows the relationship between democracy score and the natural logarithm of the number of fatalities per 100,000 motor vehicles.

There is a negative relationship between the variables. There is no clear indication of non-linearity. The general form of the model used in multiple regression was:

Table 2
Descriptive statistics for variables included in study.

Variable (abbreviation) [number]	Mean	Standard deviation	Minimum	Maximum
Fatalities per 100,000 inhabitants (Fatinh) [1]	16.63	9.35	2.0	35.9
Fatalities per 100,000 motor vehicles (Fatveh) [2]	334.04	698.35	2.6	4122.7
Ln(fatalities per 100,000 inhabitants (Lnfatpop) [3]	2.595	0.730	0.693	3.581
Ln(fatalities per 100,000 motor vehicles) (Lnfatveh) [4]	4.309	1.799	0.956	8.324
Democracy score (Demindex) [5]	5.72	2.15	1.50	9.87
Government effectiveness score (Goveff) [6]	0.021	0.963	−1.89	2.21
Score for risk factor legislation (Lawscore) [7]	0.895	0.131	0.429	1.000
Transfer value of a statistical life (VSLtrans) [8]	2.479	3.399	0.045	16.127
Motor vehicles per 1000 inhabitants (Vehpop) [9]	308.1	255.8	8	885
Alcohol consumption per capita (Alccap) [10]	6.57	4.12	0.0	15.2
Regional dummy for Asia (DumAsia) [11]	0.17	0.376	0	1
Regional dummy for Middle East (DumMid) [12]	0.09	0.294	0	1
Regional dummy for Sub Sahara Africa (DumSub) [13]	0.26	0.442	0	1
Regional dummy for North America (DumNor) [14]	0.01	0.116	0	1
Regional dummy for Latin America (DumLat) [15]	0.14	0.343	0	1
Regional dummy for Eastern Europe (DumEast) [16]	0.18	0.388	0	1
Regional dummy for Western Europe (DumWest) [17]	0.14	0.350	0	1
Data year (Datayear) [18]	2016.7	1.247	2016	2019

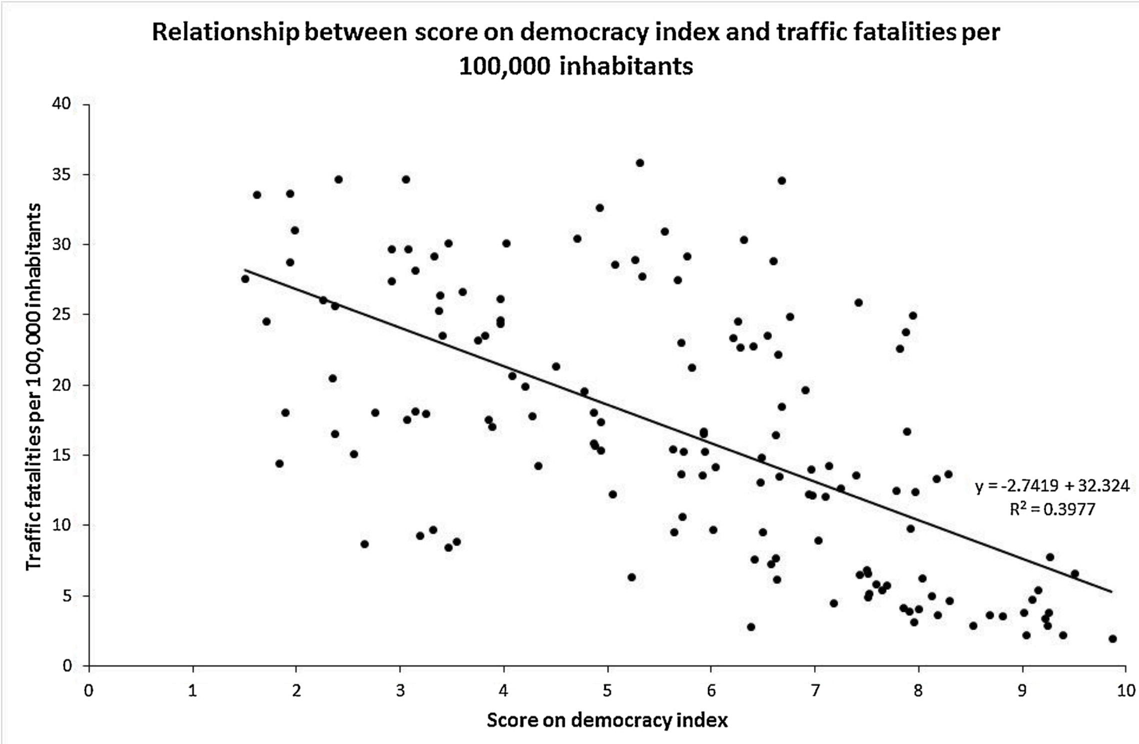

Fig. 1. Relationship between score on democracy index and traffic fatalities per 100,000 inhabitants.

Ln(fatality rate) = Constant term + Democracy indicators + Confounding variables

As mentioned in the introduction, Smeed (1949) found a negative relationship between the number of cars per inhabitant (which he denoted N/P) and the number of fatalities per car (which he denoted D/N). This is not surprising, but follows – all else equal – from the definitions of the variables. Consider what happens when N increases and D and P are held constant. The value of N/P will increase (move to the right on the abscissa) and the value of D/N will decrease (move down on the ordinate), thus generating a negative relationship between the variables. A negative relationship is not a mathematical necessity: if fatalities increase in proportion to the number of vehicles, D/N will be constant and there will be no relationship between N/P and D/N.

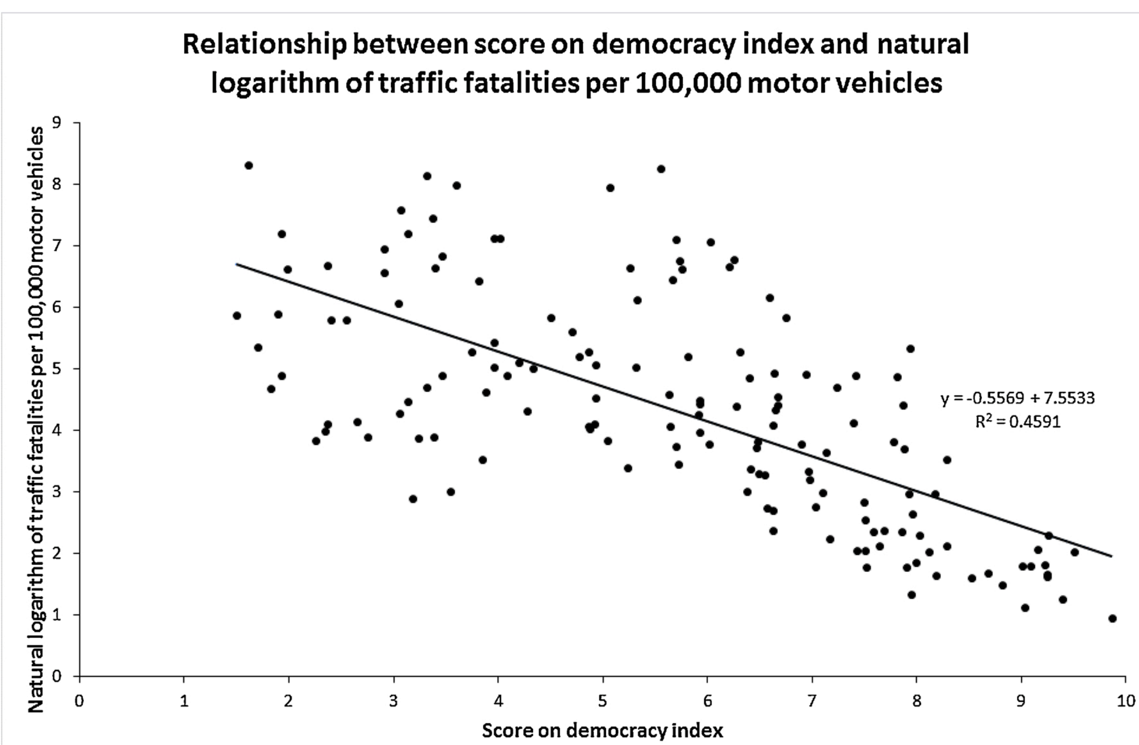

Fig. 2. Relationship between score on democracy index and natural logarithm of traffic fatalities per 100,000 motor vehicles.

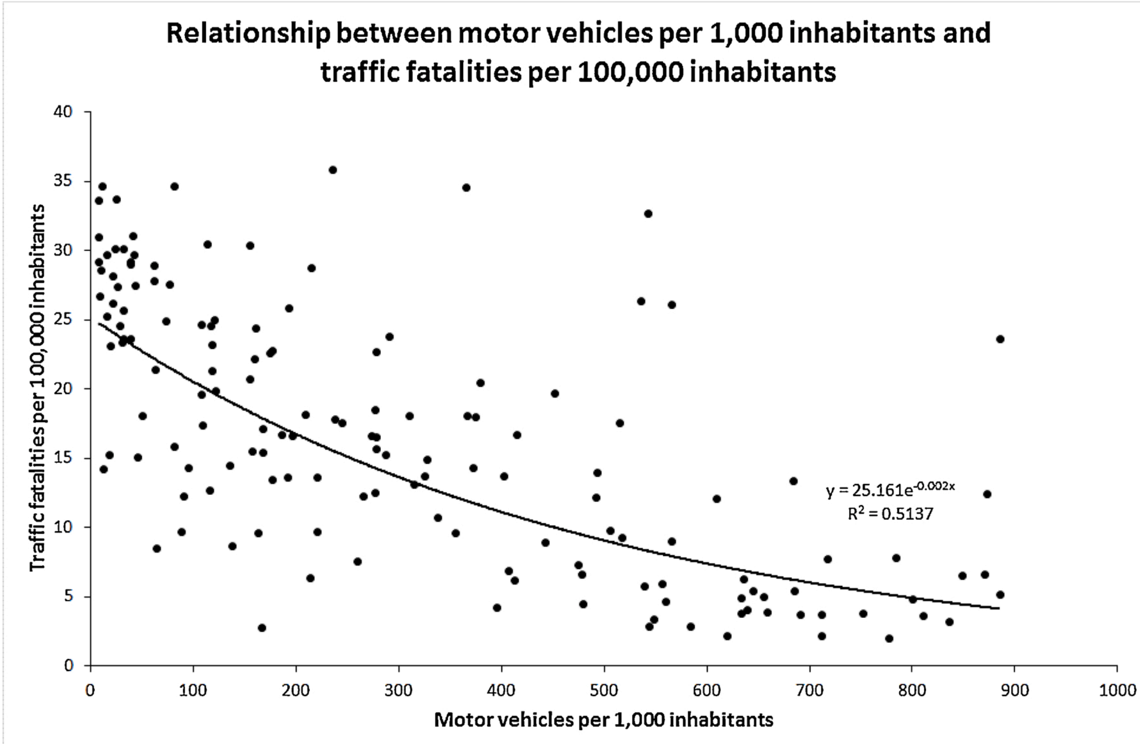

Fig. 3. Relationship between motor vehicles per 1000 inhabitants and traffic fatalities per 100,000 inhabitants.

It is perhaps more interesting to probe the relationship between the number of motor vehicles per inhabitant (N/P) and the number of fatalities per inhabitant (D/P). If increased motorisation (more vehicles per inhabitant) is associated with an increased number of fatalities, this relationship should be positive. Fig. 3 shows this relationship for the countries included in this study.

There is a negative relationship between the variables. The fewer motor vehicles per inhabitant, the higher the number of fatalities per inhabitant. In this case, however, one might expect the relationship to be positive in time-series data despite the fact that it is negative in cross-sectional data. The number of traffic fatalities increased in all the highly motorised countries from about 1945 to about 1970, when these countries motorised rapidly.

A matter of concern in any multivariate analysis is the potential for co-linearity, i.e. high correlations among the independent variables. Table 3 shows the correlations between the variables included in the study (Pearson's r). Correlations between the independent variables are highlighted in bold italics.

Most of the correlations between the independent variables are weak or moderate. Only three correlations exceed the value of 0.7. These are the correlations between government effectiveness and the transfer value of a statistical life, between the transfer value of a statistical life and vehicles per 1000 inhabitants, and between the regional dummy for Sub Saharan Africa and data year.

The regression analyses were run in four stages:

1 The first stage was a simple bivariate model with ln(fatalities/population) or ln(fatalities/vehicles) as dependent variable and democracy index as independent variable.
2 In the second stage, the other two governance indicators (government effectiveness and legal regulation of risk factors) were added.
3 In the third stage, the global confounding variables (vehicles/population, transfer value of a statistical life, alcohol/capita, data year) were added.
4 Finally, in the fourth stage, the regional dummies were added. The regional dummy for Western Europe was omitted, and served as reference category.

Table 3
Correlation matrix.

	4 FAT	5 DEM	6 GOV	7 LAW	8 VSL	9 VEH	10 ALC	11 ASIA	12 MID	13 SUB	14 NOR	15 LAT	16 EAST	17 WEST	18 YEAR
3 DEP	.852	−.669	−.791	−.502	−.758	−.717	−.499	−.005	.110	.584	−.079	.110	−.222	−.659	−.772
4 DEP		−.678	−.812	−.573	−.709	−.894	−.558	−.019	.007	.699	−.127	−.012	−.230	−.560	−.681
5 IND			*.647*	*.359*	*.542*	*.662*	*.493*	*−.037*	*−.272*	*−.300*	*.071*	*.068*	*−.082*	*.507*	*.087*
6 IND				*.610*	*.724*	*.644*	*.413*	*.319*	*.225*	*.045*	*.414*	*.262*	*.286*	*.549*	*−.441*
7 IND					*.380*	*.407*	*.342*	*.182*	*.290*	*.112*	*.349*	*.323*	*.447*	*.329*	*−.457*
8 CTR						*.717*	*.352*	*−.031*	*.099*	*−.214*	*.201*	*−.069*	*−.081*	*.648*	*−.034*
9 CTR							*.532*	*−.063*	*−.084*	*−.439*	*.110*	*−.082*	*.012*	*.583*	*.102*
10 CTR								*−.192*	*−.380*	*−.180*	*.013*	*−.066*	*.251*	*.365*	*.085*
11 CTR									*.312*	*.344*	*.365*	*.313*	*.243*	*−.183*	*−.646*
12 CTR										*.360*	*,357*	*.323*	*.263*	*−.131*	*−.620*
13 CTR											*.422*	*.361*	*.281*	*−.243*	*−.748*
14 CTR												*.369*	*.323*	*−.048*	*−.615*
15 CTR													*.260*	*.−.161*	*−.647*
16 CTR														*−.192*	*−.581*
17 CTR															*.667*
18 CTR															1

The point of conducting the analyses in stages was to assess how robust the coefficient for democracy was with respect to the number of confounding variables controlled for in the analysis.

5. Results

Table 4 presents the results of analyses using the natural logarithm of the number of road accident fatalities per 100,000 inhabitants as dependent variable.

Model 1 shows that the democracy index is negatively related to the number of fatalities per 100,000 inhabitants. In model 2, the other indicators of democracy and governance were added as independent variables. The coefficient for democracy index remains negative, but its value is closer to zero. A further approximation to zero of the value of the coefficient for democracy is seen in model 3, which adds the global confounding variables. The coefficient remains negative.

In model 4, the coefficient for democracy index becomes more negative in value and is statistically highly significant. It emerges as the most important of the three democracy and governance variables used in the analyses. The mean value for fatalities per 100,000 inhabitants is 16.63. At this value, the coefficient of -0.064 for the democracy index implies that adding one unit to it (e.g. from the mean value of 5.72–6.72) reduces the number of fatalities per 100,000 inhabitants to 12.57.

Model 4 explains nearly 88 % of the variation in natural logarithm of the number of road accident fatalities per 100,000 inhabitants. Transforming back to natural units, the residual plot shown in Fig. 4 was developed. Predicted values are shown on the abscissa, recorded values are shown on the ordinate.

The residuals are symmetrically distributed around the 45 degree line indicating perfect predictions. Thus, there is no tendency for the model to systematically over- or under-predict the number of fatalities per 100,000 inhabitants. However, the residuals are heteroskedastic, meaning that they are larger at high values of fatalities per 100,000 inhabitants than at low values. This is not unexpected, as accident data are by their nature heteroskedastic.

Turning to the number of fatalities per 100,000 motor vehicles, Table 5 shows coefficients estimated in the four models that were developed.

The results are very similar to those found for fatalities per 100,000 inhabitants. In the full model, the coefficient for the democracy index has the value of -0.075. This implies that adding one unit to the democracy index will reduce the mean number of fatalities per 100,000 motor vehicles from 334 to 309. The full model explains more than 91 % of the variation in the number of fatalities per 100,000 motor vehicles. A residual plot (not shown) indicates that model predictions are unbiased.

6. Discussion

The risk of a road accident fatality, stated both per 100,000 inhabitants and per 100,000 motor vehicles, is statistically related to how democratic a country is. For the countries included in this study, the score on the democracy index ranges from 1.50 to 9.87, with a mean value of 5.72. Imagine a country with the mean score for democracy (5.72), and the mean value of fatalities per 100,000 inhabitants (16.6). If this country dropped to the bottom score for democracy, its predicted fatality rate would be 21.8. If, on the other hand, it climbed to the top score for democracy, its predicted fatality rate would be 12.8 fatalities per 100,000 inhabitants.

These predictions are, of course, illustrative only. The data are cross-sectional and say nothing about the effects on fatality rates of changes over time in the democracy index or any of the other variables included in the analyses. Is it nevertheless likely that the statistical relationships found in the study reflect causal relationships?

Two conditions must be fulfilled to give a positive answer to this question. First, the analyses presented in this paper should not be influenced by any of the problems of multivariate analyses that preclude a causal interpretation of their findings (Elvik, 2011). Second, the findings should be replicated in studies showing changes over time in the relevant variables.

With respect to the first condition, the main threats to validity include: endogeneity, multicollinearity, omitted variable bias, and wrong functional form for the relationship between the independent and dependent variables (Kennedy, 2003). Endogeneity means that the dependent variable influences one or more of the independent variables, which are then not truly independent. The independent variable of principal interest in this study is the score on the democracy index. It is not likely that this is influenced by the road accident fatality rate. The only independent variable that might be influenced by the road accident fatality rate, is the score for legislation regulating risk factors. It is not altogether unreasonable to suggest that this legislation might be introduced partly as a result of a high fatality rate. However, it has a negative correlation with fatality rate, suggesting that legislation is less likely to be fully implemented when fatality rate is high than when it is low.

To assess multicollinearity, the variance inflation factor (Kennedy, 2003) was estimated for all independent variables, except the regional dummy for Western Europe, which was omitted from all models (because the full set of dummy variables are perfectly collinear). The values ranged from 1.11 to 6.29. These are all below the value of 10, which indicates harmful collinearity.

Omitted variable bias occurs when a variable not included in the model is statistically associated both with the dependent variable and one or more independent variables included in the model. The coefficient for the included variable will then be biased by partly reflecting the influence of the omitted variable. A stepwise regression model, in which independent variables are

Table 4
Models predicting fatalities per 100,000 inhabitants.

	Models explaining the natural logarithm of the number of traffic fatalities per 100,000 inhabitants. Least squares linear regression. Coefficients (standard errors in parentheses) [P-value in brackets]			
	Model 1	Model 2	Model 3	Model 4
Constant term	3.895 (0.128) [0.000]	3.485 (0.314) [0.000]	488.583 (72.468) [0.000]	314.472 (69.138) [0.000]
Democracy index	−0.227 (0.021) [0.000]	−0.046 (0.026) [0.082]	−0.035 (0.022) [0.111]	−0.064 (0.020) [0.002]
Government effectiveness		−0.473 (0.061) [0.000]	−0.188 (0.071) [0.009]	−0.099 (0.057) [0.087]
Lawscore		−0.689 (0.324) [0.035]	−0.405 (0.272) [0.139]	−0.074 (0.225) [0.742]
VSLtransfer			−0.056 (0.015) [0.000]	−0.081 (0.013) [0.000]
Alcohol/capita			0.008 (0.010) [0.405]	0.010 (0.009) [0.250]
Vehicles/capita			0.000 (0.000) [0.861]	0.000 (0.000) [0.017]
Data year			−0.241 (0.036) [0.000]	−0.155 (0.034) [0.000]
DumAsia				0.215 (0.119) [0.074]
DumMid				0.474 (0.134) [0.001]
DumSub				0.717 (0.128) [0.000]
DumNor				0.670 (0.203) [0.001]
DumLat				0.430 (0.127) [0.001]
DumEast				−0.041 (0.109) [0.709]
R^2	0.448	0.646	0.784	0.876
N	148	148	145	145

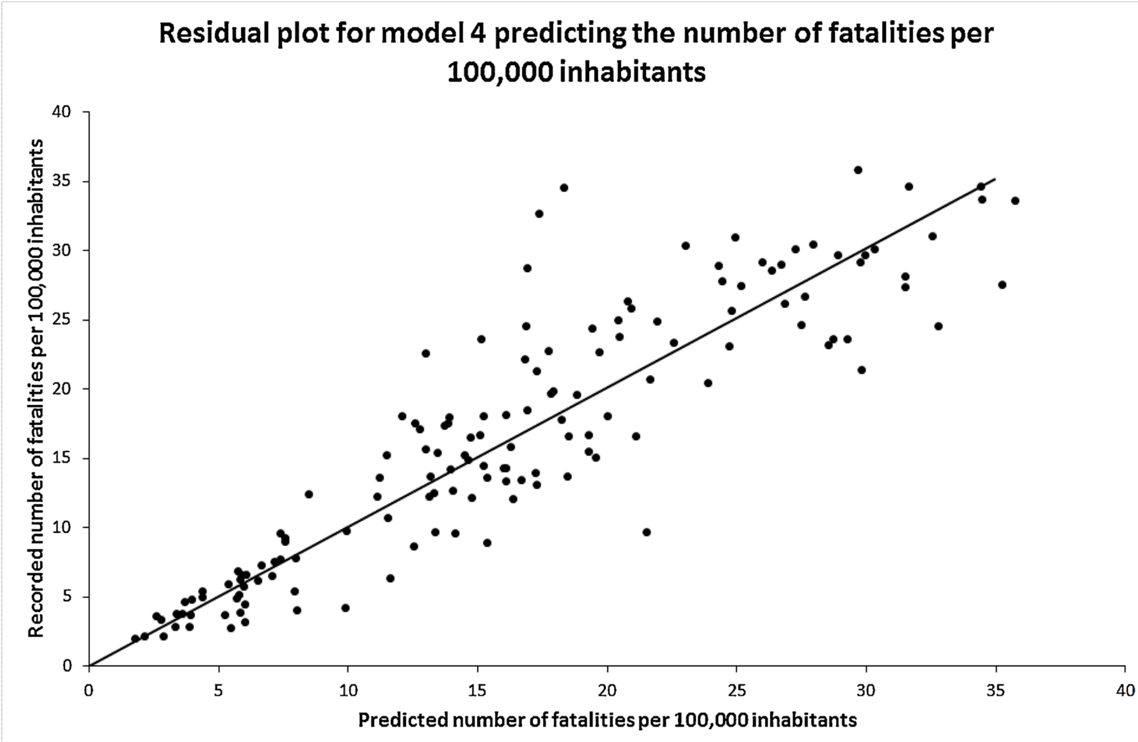

Fig. 4. Residual plot for model 4 predicting the number of fatalities per 100,000 inhabitants.

added one-by-one, may give some clues about the possible presence of omitted variable bias. If the regression coefficient of a variable changes sign or value when another variable is added to the model, this indicates that bias would have been present if the added variable had been omitted.

Of course, this says nothing about variables that were never included in the model. It is easy to think of more potentially relevant variables than those included in the models developed in this paper. For example, population density, the age distribution of the population, the quality of roads, the age of cars, the share of motorcycles, the quality of medical care, the climate zone a country is located in, and many others, may be associated both with fatality rate and one or more of the variables included in this study. Strictly speaking, the potential presence of omitted variable bias can never be ruled out in models of the kind developed in this paper.

That said, it should be added that it is impossible to know when all relevant variables have been included in a model. This study included 148 countries. If, as a rule of thumb, there should be at least 10 observations for each variable, the maximum number of variables that can be included is 15. The study included 11 variables classified as potentially confounding, and three independent variables of principal interest. This is about as many variables as it makes sense to include.

The functional form of the relationship between the independent variables and the dependent variable can be specified in many ways. The simplest is a linear relationship. Other possibilities include log-linear, log-log, quadratic, or higher order non-linear relationships.

The models developed in this paper are log-linear: the natural logarithm of the dependent variable is regressed on a linear combination of the independent variables. This type of model is very common, see e.g. Viscusi and Masterman (2017) and Carlsen and Leknes (2020) for examples. Whether this functional relationship is appropriate, can be examined by means of a cumulative residual plot (cure-plot) (Hauer and Bamfo, 1997; Hauer, 2015). Fig. 5 shows a cure-plot for the model predicting fatalities per 100,000 inhabitants.

Five outlying data points were omitted when plotting the cure-plot. It mostly stays within the dashed lines indicating plus or minus two standard deviations. It is clear, however, that high rates of fatalities per 100,000 inhabitants tend to be under-predicted more often than over-predicted. The regional dummies may not fully capture the large differences between regions of the world with respect to fatalities per 100,000 inhabitants. The functional form is not necessarily wrong, but there may be cultural aspects of countries with a high fatality rate per 100,000 inhabitants that are not fully captured by the variables included in the study.

It is concluded that the models developed do not support a causal interpretation, but show real statistical relationships and give, except for a few outliers, unbiased estimates of risk.

The democracy index started in 2006. The governance indicators of the World Bank go back to 1996. To test if the coefficients found in the cross-sectional analysis are replicated in data for different time periods, the government effectiveness index for 1996, 2007 and 2019 was recorded. Changes over time were stated as ratios. Thus, a country scoring 1.52 in 1996 and 1.65 in 2007 was given the value $1.65/1.52 = 1.086$. These ratios varied between countries, depending on whether their government became more or less effective from 1996 to 2007 and from 2007 to 2019. The number of traffic fatalities per 100,000 inhabitants for the same three years was extracted from the IRTAD database. Data were available for 28 high-income countries.

For the first period (1996–2007) a very weak tendency was found for countries improving the government effectiveness score to also accomplish a greater reduction of fatality rate than countries not improving the government effectiveness score. The direction of the relationship is the same as implied by the coefficient for government effectiveness in the multivariate model. In second period (2007–2019) there was no statistical association at all between changes in government effectiveness and the size of the reduction of fatality rate. At best, these analyses suggest that the negative coefficient found for government effectiveness in the cross-sectional model may perhaps be replicated in time-series data, but not necessarily imply the same strength of the relationship.

7. Conclusions

The main conclusions of the study presented in this paper can be summarised as follows:

Table 5
Models predicting fatalities per 100,000 motor vehicles.

	Models explaining natural logarithm of number of traffic fatalities per 100,000 motor vehicles. Least squares linear regression. Coefficients (standard errors in parentheses) [P-value in brackets]			
	Model 1	Model 2	Model 3	Model 4
Constant term	7.553 (0.311) [0.000]	7.396 (0.714) [0.000]	184.572 (148.062) [0.215]	10.437 (142.265) [0.942]
Democracy index	−0.567 (0.051) [0.000]	−0.088 (0.060) [0.144]	−0.005 (0.045) [0.904]	−0.075 (0.041) [0.068]
Government effectiveness		−1.168 (0.139) [0.000]	−0.446 (0.144) [0.002]	−0.251 (0.118) [0.035]
Lawscore		−2.859 (0.738) [0.000]	−1.552 (0.556) [0.006]	−0.503 (0.462) [0.279]
VSLtransfer			−0.001 (0.031) [0.976]	−0.048 (0.028) [0.086]
Alcohol/capita			−0.018 (0.019) [0.365]	−0.039 (0.018) [0.033]
Vehicles/capita			−0.004 (0.000) [0.000]	−0.003 (0.000) [0.000]
Data year			−0.088 (0.073) [0.233]	−0.002 (0.071) [0.976]
DumAsia				0.206 (0.246) [0.402]
DumMid				−0.001 (0.276) [0.996]
DumSub				1.241 (0.263) [0.000]
DumNor				0.956 (0.418) [0.024]
DumLat				0.271 (0.262) [0.304]
DumEast				−0.247 (0.224) [0.272]
R^2	0.459	0.698	0.850	0.913
N	148	148	145	145

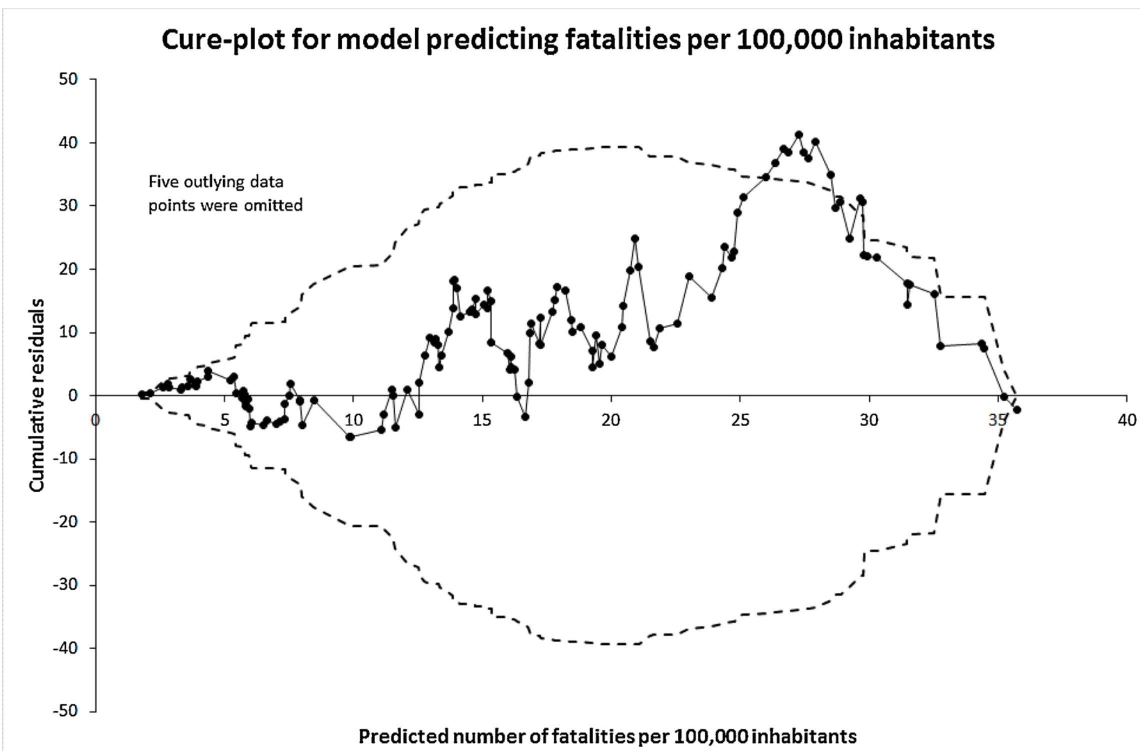

Fig. 5. Cure-plot for model predicting fatalities per 100,000 inhabitants.

1 A negative statistical relationship is found between score on the democracy index and road accident fatality rate (per 100,000 inhabitants or per 100,000 motor vehicles).
2 This statistical relationship is robust with respect to control for potentially confounding variables.
3 The statistical models developed do not justify a causal interpretation of the relationship between democracy, governance and road safety. There is, however, no doubt that the relationship is real irrespective of causality.
4 Time-series data for the government effectiveness indicator of the global governance indicators developed by the World Bank suggest a very weak negative relationship: improving government effectiveness is weakly associated with greater reduction of road accident fatality rate.

Declaration of Competing Interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

The study presented in this paper received no funding from any public or private organisation.

Appendix A

Table A1
Data for all countries.

Country	Fat/ cap10ˆ5	Fat/ veh10ˆ5	Veh/ 1000	Demindex	Goveff	Alc/ inh	VSLtrans	Lawscore	Asia	Mid	Sub	Lat	East	West	Nor	Datayear
Afghanistan	15.1	332.7	45	2.55	−1.33	0.2	0.105	0.43	1	0	0	0	0	0	0	2016
Albania	13.6	70.9	192	5.91	0.01	7.5	0.736	1.00	0	0	0	0	1	0	0	2016
Angola	23.6	772.4	32	3.40	−1.04	6.4	0.719	1.00	0	0	1	0	0	0	0	2016
Argentina	14.0	28.3	493	6.96	0.16	9.8	2.144	1.00	0	0	0	1	0	0	0	2016
Armenia	17.1	102.0	167	3.88	−0.16	5.5	0.668	0.86	0	0	0	0	1	0	0	2016
Australia	4.8	6.0	800	9.09	1.57	10.6	10.335	1.00	1	0	0	0	0	0	0	2019
Austria	4.7	8.4	560	8.29	1.49	11.6	8.157	1.00	0	0	0	0	0	1	0	2019
Azerbaijan	8.7	63.5	137	2.65	−0.17	0.8	1.129	0.86	0	0	0	0	1	0	0	2016
Bangladesh	15.3	869.5	18	5.73	−0.68	0.0	0.205	0.57	1	0	0	0	0	0	0	2016
Belarus	8.9	20.1	442	3.54	−0.48	11.2	1.111	1.00	0	0	0	0	1	0	0	2016
Belgium	5.4	8.4	645	7.64	1.03	12.1	7.613	1.00	0	0	0	0	0	1	0	2019
Benin	27.5	635.6	43	5.67	−0.56	3.0	0.145	0.43	0	0	1	0	0	0	0	2016
Bhutan	17.4	159.6	109	4.93	0.50	0.6	0.409	0.86	1	0	0	0	0	0	0	2016
Bolivia	15.5	98.7	157	5.63	−0.57	4.8	0.516	0.71	0	0	0	1	0	0	0	2016
Bosnia	15.7	56.5	278	4.87	−0.39	8.4	0.803	1.00	0	0	0	0	1	0	0	2016
Botswana	23.8	82.1	290	7.87	0.53	8.4	1.111	1.00	0	0	1	0	0	0	0	2016
Brazil	19.7	43.6	452	6.90	−0.17	7.8	1.695	1.00	0	0	0	1	0	0	0	2016
Bulgaria	9.0	15.9	565	7.03	0.34	12.7	1.287	1.00	0	0	0	0	1	0	0	2019
Burkina Faso	30.5	269.9	113	4.70	−0.56	8.2	0.110	1.00	0	0	1	0	0	0	0	2016
Burundi	34.7	328.3	11	2.40	−1.44	7.5	0.045	0.71	0	0	1	0	0	0	0	2016
Cabo Verde	25.0	208.3	120	7.94	0.13	5.7	0.564	0.71	0	0	1	0	0	0	0	2016
Cambodia	17.8	74.8	238	4.27	−0.69	6.7	0.184	1.00	1	0	0	0	0	0	0	2016
Cameroon	30.1	940.6	32	3.46	−0.76	8.9	0.227	0.71	0	0	1	0	0	0	0	2016
Canada	5.4	7.9	685	9.15	1.72	8.9	8.179	1.00	0	0	0	0	0	0	1	2018
Central African Republic	33.6	4122.7	8	1.61	−1.77	3.3	0.057	0.71	0	0	1	0	0	0	0	2016
Chad	27.6	354.7	77	1.50	−1.51	1.5	0.151	0.71	0	0	1	0	0	0	0	2016
Chile	12.5	45.1	277	7.78	1.01	9.3	2.426	1.00	0	0	0	1	0	0	0	2016
China	18.2	87.1	209	3.14	0.35	7.2	1.364	0.86	1	0	0	0	0	0	0	2016
Colombia	18.5	83.3	277	6.67	0.02	5.8	1.228	0.86	0	0	0	1	0	0	0	2016
Congo	27.4	1053.8	26	2.91	−1.10	7.8	0.437	0.71	0	0	1	0	0	0	0	2016
Costa Rica	16.7	40.2	415	7.88	0.36	4.8	1.789	1.00	0	0	0	1	0	0	0	2016
Croatia	7.3	15.4	474	6.57	0.41	8.9	2.185	1.00	0	0	0	0	1	0	0	2019
Cuba	8.5	132.8	64	3.46	−0.10	6.1		0.86	0	0	0	1	0	0	0	2016
Cyprus	5.9	10.6	556	7.59	0.99	10.8	4.471	1.00	0	0	0	0	0	1	0	2019
Czech Republic	5.8	10.8	539	7.69	0.89	14.4	3.121	1.00	0	0	0	0	1	0	0	2019
Dem Rep of Congo	33.7	1348.0	25	1.93	−1.51	2.6	0.071	0.57	0	0	1	0	0	0	0	2016
Denmark	3.4	6.2	548	9.22	1.94	10.4	10.073	1.00	0	0	0	0	0	1	0	2019
Dominican Republic	34.6	94.8	365	6.67	−0.26	6.9	1.074	1.00	0	0	0	1	0	0	0	2016
Ecuador	21.3	180.5	118	5.81	−0.43	4.4	1.037	1.00	0	0	0	1	0	0	0	2016
Egypt	9.7	110.2	88	3.31	−0.66	0.4	0.575	0.86	0	1	0	0	0	0	0	2016
El Salvador	22.2	139.6	159	6.64	−0.29	3.7	0.678	1.00	0	0	0	1	0	0	0	2016
Equatorial Guinea	24.6	210.3	117	1.70	−1.41	11.3	2.206	0.71	0	0	1	0	0	0	0	2016
Eritrea	25.3	1732.8	15	3.37	−1.70	1.3		1.00	0	0	1	0	0	0	0	2016
Estonia	3.9	5.9	659	7.90	1.17	11.6	3.159	1.00	0	0	0	0	1	0	0	2019
Ethiopia	26.7	2966.6	9	3.60	−0.64	2.8	0.102	0.86	0	0	1	0	0	0	0	2016
Fiji	9.6	58.8	163	5.64	−0.25	3.0	0.831	1.00	1	0	0	0	0	0	0	2016
Finland	3.8	5.1	752	9.25	1.93	10.7	8.009	1.00	0	0	0	0	0	1	0	2019
France	5.0	7.6	655	8.12	1.38	12.6	6.975	1.00	0	0	0	0	0	1	0	2019
Gabon	23.2	196.6	118	3.74	−0.79	11.5	1.583	0.71	0	0	1	0	0	0	0	2016
Gambia	29.7	706.9	42	2.91	−0.84	3.8	0.079	1.00	0	0	1	0	0	0	0	2016
Georgia	15.3	53.3	287	5.93	0.52	9.8	0.716	0.86	0	0	0	0	1	0	0	2016
Germany	3.7	5.4	691	8.68	1.59	13.4	7.904	1.00	0	0	0	0	0	1	0	2019
Ghana	24.9	341.1	73	6.75	−0.17	2.7	0.255	0.86	0	0	1	0	0	0	0	2016
Greece	6.5	7.7	848	7.43	0.41	10.4	3.496	1.00	0	0	0	0	0	1	0	2019
Guatemala	16.6	84.7	196	5.92	−0.61	2.4	0.618	0.86	0	0	0	1	0	0	0	2016
Guinea	28.2	1343.9	21	3.14	−1.64	1.3	0.081	0.71	0	0	1	0	0	0	0	2016
Guinea Bissau	31.1	758.5	41	1.98	−1.01	4.8	0.102	1.00	0	0	1	0	0	0	0	2016
Guyana	24.6	878.5	28	6.25	−0.30	6.3	0.704	0.86	0	0	0	1	0	0	0	2016
Honduras	16.7	89.8	186	5.92	−0.73	4.0	0.392	0.86	0	0	0	1	0	0	0	2016
Hungary	6.2	15.0	412	6.63	0.50	11.4	2.233	1.00	0	0	0	0	1	0	0	2019
Iceland	6.6	7.6	870	9.50	1.39	9.1	8.626	1.00	0	0	0	0	0	1	0	2016
India	22.6	129.9	174	7.81	0.08	5.7	0.275	0.86	1	0	0	0	0	0	0	2016
Indonesia	12.2	24.8	492	6.97	0.01	0.8	0.592	0.86	1	0	0	0	0	0	0	2016
Iran	20.5	54.1	379	2.34	−0.19	1.0	1.127	0.86	0	1	0	0	0	0	0	2016
Iraq	20.7	133.5	155	4.08	−1.27	0.4	1.001	0.86	0	1	0	0	0	0	0	2016
Ireland	2.9	5.3	544	9.24	1.28	13.0	9.046	1.00	0	0	0	0	0	1	0	2019
Israel	4.2	10.6	395	7.85	1.35	3.8	6.154	1.00	0	1	0	0	0	0	0	2016
Italy	5.2	5.9	885	7.52	0.46	7.5	5.645	1.00	0	0	0	0	0	1	0	2019
Ivory Coast	23.6	620.9	38	3.81	−0.67	8.4	0.244	0.71	0	0	1	0	0	0	0	2016

(*continued on next page*)

Table A1 (*continued*)

Country	Fat/ cap10ˆ5	Fat/ veh10ˆ5	Veh/ 1000	Demindex	Goveff	Alc/ inh	VSLtrans	Lawscore	Asia	Mid	Sub	Lat	East	West	Nor	Datayear
Jamaica	13.6	61.8	220	7.39	0.41	4.2	0.869	0.86	0	0	0	1	0	0	0	2016
Japan	4.1	6.4	639	7.99	1.82	8.0	6.682	1.00	1	0	0	0	0	0	0	2016
Jordan	24.4	151.5	161	3.96	0.13	0.7	0.805	0.86	0	1	0	0	0	0	0	2016
Kazakhstan	17.6	72.1	244	3.06	−0.07	7.7	1.960	1.00	0	0	0	0	1	0	0	2016
Kenya	27.8	455.6	61	5.33	−0.32	3.4	0.231	0.86	0	0	1	0	0	0	0	2016
Kuwait	17.6	34.2	515	3.85	−0.16	0.0	7.252	0.86	0	1	0	0	0	0	0	2016
Kyrgyzstan	15.4	92.2	167	4.93	−0.90	6.2	0.201	0.86	0	0	0	0	1	0	0	2016
Laos	16.6	60.8	273	2.37	−0.40	10.4	0.299	0.86	1	0	0	0	0	0	0	2016
Latvia	6.9	17.0	407	7.49	1.11	12.9	2.577	1.00	0	0	0	0	1	0	0	2019
Lebanon	18.1	58.4	310	4.86	−0.54	1.5	1.326	1.00	0	1	0	0	0	0	0	2016
Lesotho	28.9	473.7	61	6.59	−0.80	5.0	0.220	0.71	0	0	1	0	0	0	0	2016
Liberia	35.9	152.8	235	5.31	−1.28	5.8	0.380	0.71	0	0	1	0	0	0	0	2016
Libya	26.1	46.2	565	2.25	−1.89	0.0		0.86	0	1	0	0	0	0	0	2016
Lithuania	6.6	12.8	478	7.50	1.04	15.0	2.570	1.00	0	0	0	0	1	0	0	2019
Luxembourg	3.6	4.4	810	8.81	1.73	13.0	13.247	1.00	0	0	0	0	0	1	0	2019
Macedonia	6.4	30.0	213	5.23	0.10	8.1	0.884	1.00	0	0	0	0	1	0	0	2016
Madagascar	28.6	2860.0	10	5.07	−1.17	1.9	0.072	0.86	0	0	1	0	0	0	0	2016
Malawi	31.0	3875.0	8	5.55	−0.73	3.7	0.058	0.86	0	0	1	0	0	0	0	2016
Malaysia	23.6	26.7	885	6.54	0.87	0.9	1.819	0.71	1	0	0	0	0	0	0	2016
Mali	23.1	1215.8	19	5.70	−0.99	1.3	0.131	0.86	0	0	1	0	0	0	0	2016
Malta	3.2	3.8	836	7.95	0.86	8.1	4.117	1.00	0	0	0	0	0	1	0	2019
Mauritania	24.7	228.7	108	3.96	−0.77	0.0	0.236	0.86	0	0	1	0	0	0	0	2016
Mauritius	13.7	34.1	402	8.28	0.96	3.6	1.683	0.86	0	0	1	0	0	0	0	2016
Mexico	13.1	41.6	315	6.47	0.13	6.5	1.671	0.43	0	0	0	1	0	0	0	2016
Mongolia	16.5	59.4	278	6.62	−0.10	7.4	0.666	0.86	1	0	0	0	0	0	0	2016
Montenegro	10.7	31.7	338	5.72	0.13	8.0	1.242	1.00	0	0	0	0	1	0	0	2016
Morocco	19.6	183.2	107	4.77	−0.11	0.6	0.521	0.86	0	1	0	0	0	0	0	2016
Mozambique	30.1	1254.2	24	4.02	−0.86	2.4	0.102	1.00	0	0	1	0	0	0	0	2016
Myanmar	19.9	164.5	121	4.20	−0.98	4.8	0.200	0.71	1	0	0	0	0	0	0	2016
Namibia	30.4	196.1	155	6.31	0.17	9.8	0.893	0.86	0	0	1	0	0	0	0	2016
Nepal	15.9	196.3	81	4.86	−0.83	2.0	0.126	0.71	1	0	0	0	0	0	0	2016
Netherlands	3.8	6.0	633	9.01	1.80	8.7	8.406	1.00	0	0	0	0	0	1	0	2019
New Zealand	7.8	9.9	784	9.26	1.84	10.7	6.885	1.00	1	0	0	0	0	0	0	2016
Niger	26.2	1247.6	21	3.96	−0.63	0.5	0.067	0.71	0	0	1	0	0	0	0	2016
Nigeria	21.4	339.7	63	4.50	−1.09	13.4	0.485	1.00	0	0	1	0	0	0	0	2016
Norway	2.0	2.6	777	9.87	1.86	7.5	16.127	1.00	0	0	0	0	0	1	0	2019
Pakistan	14.3	150.4	95	4.33	−0.65	0.3	0.248	0.86	1	0	0	0	0	0	0	2016
Panama	14.3	38.4	372	7.13	0.19	7.9	2.044	0.86	0	0	0	1	0	0	0	2016
Papua New Guinea	14.2	1183.9	12	6.03	−0.74	1.2	0.385	0.86	1	0	0	0	0	0	0	2016
Paraguay	22.7	81.7	278	6.27	−0.79	7.2	0.721	1.00	0	0	0	1	0	0	0	2016
Peru	13.5	76.7	176	6.65	−0.18	6.3	1.055	1.00	0	0	0	1	0	0	0	2016
Philippines	12.3	135.0	90	6.94	−0.01	6.6	0.611	0.86	1	0	0	0	0	0	0	2016
Poland	7.7	10.7	717	6.62	0.60	11.6	2.295	1.00	0	0	0	0	1	0	0	2019
Portugal	6.3	9.9	635	8.03	1.15	12.3	3.532	1.00	0	0	0	0	0	1	0	2019
Qatar	9.3	18.0	517	3.18	0.74	2.0	14.450	0.86	0	1	0	0	0	0	0	2016
Republic of Moldova	9.7	44.1	220	6.01	−0.63	15.2	0.385	1.00	0	0	0	0	1	0	0	2016
Romania	9.6	27.0	355	6.49	−0.28	12.6	1.634	1.00	0	0	0	0	1	0	0	2019
Russia	18.0	48.0	375	3.24	−0.20	11.7	1.970	1.00	0	0	0	0	1	0	0	2016
Rwanda	29.7	1980.0	15	3.07	0.10	9.0	0.120	0.57	0	0	1	0	0	0	0	2016
Saudi Arabia	28.8	134.6	214	1.93	0.26	0.2	4.052	1.00	0	1	0	0	0	0	0	2016
Senegal	23.4	779.9	30	6.21	−0.45	0.7	0.169	0.86	0	0	1	0	0	0	0	2016
Serbia	7.6	29.3	259	6.41	0.02	11.1	0.953	1.00	0	0	0	0	1	0	0	2019
Singapore	2.8	20.2	166	6.38	2.21	2.0	8.962	1.00	1	0	0	0	0	0	0	2016
Slovakia	4.5	9.4	479	7.17	0.67	11.5	3.023	1.00	0	0	0	0	1	0	0	2019
Slovenia	4.9	7.7	633	7.50	1.08	12.6	3.818	1.00	0	0	0	0	1	0	0	2019
South Africa	25.9	134.2	193	7.41	0.31	9.3	1.046	1.00	0	0	1	0	0	0	0	2016
South Korea	9.8	19.4	506	7.92	1.06	10.2	4.723	0.86	1	0	0	0	0	0	0	2016
Spain	3.7	5.2	712	8.18	1.12	10.0	4.908	1.00	0	0	0	0	0	1	0	2019
Sri Lanka	14.9	45.6	327	6.48	−0.03	4.3	0.654	0.86	1	0	0	0	0	0	0	2016
Sudan	25.7	803.1	32	2.37	−1.52	0.5	0.330	0.86	0	1	0	0	0	0	0	2016
Sweden	2.2	3.5	620	9.39	1.83	9.2	9.965	1.00	0	0	0	0	0	1	0	2019
Switzerland	2.2	3.1	712	9.03	1.95	11.5	14.560	1.00	0	0	0	0	0	1	0	2019
Tajikistan	18.1	362.0	50	1.89	−1.03	3.3	0.220	0.86	0	0	0	0	1	0	0	2016
Tanzania	29.2	748.7	39	5.76	−0.55	9.4	0.158	0.71	0	0	1	0	0	0	0	2016
Thailand	32.7	60.3	542	4.92	0.34	8.3	0.984	0.86	1	0	0	0	0	0	0	2016
Timor-Leste	12.7	109.5	116	7.24	−1.01	2.1	0.375	0.86	1	0	0	0	0	0	0	2016
Togo	29.2	3476.2	8	3.32	−1.07	3.1	0.093	0.71	0	0	1	0	0	0	0	2016
Trinidad and Tobago	12.1	19.9	609	7.10	0.23	8.4	3.035	1.00	0	0	0	1	0	0	0	2016
Tunisia	22.8	128.8	177	6.40	−0.23	1.9	0.685	0.86	0	1	0	0	0	0	0	2016
Turkey	12.3	46.4	265	5.04	0.05	2.0	1.712	1.00	0	0	0	0	0	1	0	2016
Turkmenistan	14.5	107.8	135	1.83	−1.13	5.4	1.270	0.71	0	0	0	0	1	0	0	2016
Uganda	29.0	763.2	38	5.26	−0.57	9.5	0.120	0.86	0	0	1	0	0	0	0	2016

(*continued on next page*)

Table A1 (*continued*)

Country	Fat/ cap10ˆ5	Fat/ veh10ˆ5	Veh/ 1000	Demindex	Goveff	Alc/ inh	VSLtrans	Lawscore	Asia	Mid	Sub	Lat	East	West	Nor	Datayear
Ukraine	13.7	42.2	325	5.70	−0.57	8.6	0.454	1.00	0	0	0	0	1	0	0	2016
United Arab Emirates	18.1	49.5	366	2.75	1.42	3.8	7.413	1.00	0	1	0	0	0	0	0	2016
United Kingdom	2.9	5.0	584	8.52	1.44	11.4	7.465	1.00	0	0	0	0	0	1	0	2019
United States	12.4	14.2	873	7.96	1.58	9.8	9.631	1.00	0	0	0	0	0	0	1	2018
Uruguay	13.4	19.6	684	8.17	0.57	10.8	2.705	1.00	0	0	0	1	0	0	0	2016
Vietnam	26.4	49.2	536	3.38	0.02	8.3	0.342	0.86	1	0	0	0	0	0	0	2016
Zimbabwe	34.7	428.4	81	3.05	−1.16	4.8	0.148	0.86	0	0	1	0	0	0	0	2016

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