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Road safety determinants: do institutions matter?

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1. INTRODUCTION

In 2010 the United Nations General Assembly adopted resolution 64/255 declaring 2011–2020 the Decade of Action for Road Safety with the main goal of stabilizing and then reducing the level of road traffic fatalities (United Nations, 2010). Support for this action from the world's governments reflects the growing awareness that road traffic accidents and fatalities constitute a global public health problem. In short, the fact that 1.24 million people lost their lives on the roads in 2010 (World Health Organization [WHO], 2013a) and that traffic injuries were the eighth leading cause of death globally (Lozano et al., 2012) can no longer be overlooked.

The problem is particularly alarming in low- and middle-income countries. According to the WHO, 92% of deaths on roads in 2010 occurred in such countries, although they concentrate just 53% of the world's vehicle fleet (WHO, 2013a). The number of fatalities among vulnerable road users (i.e., pedestrians, motorcyclists and cyclists) is also higher in low- and middle- income countries. In addition, road traffic crashes are associated with high economic costs that seem to hit developing economies hardest, with 59% of fatalities occurring among adults who are often the family's sole breadwinner. A study conducted in Bangladesh and India[1] shows that most families affected by a road traffic fatality experience a significant decline in household income, often causing them to fall below the poverty line (Commission for Global Road Safety, 2007). The loss not only affects the victim's family, but also puts a burden on the nation, whose overall productivity is affected by the exit from the labor market of some of its most productive workers. In 2005 the costs of road traffic crashes in low- and middle-income countries amounted to US$65 billion, while globally the loss was US$518 billion, representing between 1 and 3% of the world's gross national product (WHO, 2013a, 2013b).

[1] A study conducted in 2004 by the Transport Research Laboratory commissioned by the Global Road Safety Partnership. Available at www.grsproadsafety.org

Although some of these losses are unavoidable, many are preventable. Today, road safety is generally assumed to be the shared responsibility of governments and civil society, but reducing the burden of traffic accidents still falls largely on the state authorities. There is substantial evidence from studies of road safety and its determinants to show that governments can play an active role. Taking their lead from Nilsson (2002), for instance, Elvik, Høye, Vaa, and Sørensen (2009) identify 128 road safety measures which governments can use to enhance road safety. These measures address all aspects of road systems and allow ample scope for action in the public sector, where road authorities can be joined by other public institutions – including the health authorities (hospitals, ambulance services), the police force and education authorities – in the provision of road safety. Indeed, public sector policymakers can be viewed as "producers of traffic safety", which in turn can be characterized as a public good that is "consumed by the general public" (Maier, Gerking, & Weiss, 1989). It is reasonable, therefore, to suppose that if a set of factors has a significant impact on a government's provision of public goods, these factors should also influence the provision of road safety as a public good.

The research also shows that the quality and quantity of public goods vary systematically according to a country's political institutions and economic policy. On the one hand, theoretical research on economic policy outcomes has developed and empirically tested several models on how electoral rules and forms of government influence the size and composition of government spending. The models presented by Lizzeri and Persico (2001), Milesi-Ferretti, Perotti, and Rostagno (2002), and Persson and Tabellini (2000) predict that governments elected by proportional representation are more likely to implement public spending programs that benefit large groups of the population. In their theoretical research on the impact of different forms of government on public spending, Persson, Roland, and Tabellini (2000) develop a formal model which predicts that presidential regimes lead to smaller governments and less redistribution than is the case under parliamentary democracies. These predictions are empirically tested by Persson and Tabellini (2004), who find that electoral rules and forms of government shape the size and composition of government spending. More evidence supporting the theoretical priors is provided in Persson and Tabellini (2003).

Additionally, research on government spending and the provision of public goods under dictatorship and democracy finds that democratization generally has a significant impact on public outlay. McGuire and Olson (1996), among others, predict higher levels of public good provision under democracies than under dictatorships and Bueno De Mesquita, Smith, Siverson, and Morrow (2003), Deacon (2009), Lake and Baum (2001) present empirical evidence to support this, although Mulligan, Gil, and Sala-i-Martin (2004) find no significant difference in the provision of social and economic policies under the two types of regime.

The impact of democratic institutions on policy outcomes can be particularly important in developing countries, whose political institutions have undergone significant transformations in recent decades: less than 10% of low-income and only one third of middle-income countries were democracies in 1975 (Figure 1), while these percentages increased to more than 80% by 2009. The institutional changes brought about by democratization have led to significant modifications in their systems of governance and have had a marked impact on different aspects of the public sector.

<<Insert Figure 1 about here >>

Road safety is one of the outcomes that appears to have benefited from this democratization process: the evidence in Figure 2 shows that democratic institutions are associated with better road safety, which suggests that research should be conducted into the role of institutions and the causal links between democratization and road safety.

<<Insert Figure 2 about here >>

To date, few academic studies have addressed the relationship between institutions and road safety outcomes. Anbarci, Escaleras, and Register (2006) analyzed the association between public sector corruption and traffic fatalities. Grimm and Treibich (2010) used indices of institutional quality to study the effect of income on variability in traffic fatalities. Law, Noland, and Evans (2009) considered governance and the quality of political institutions to explore the factors underlying the Kuznets curve relationship for motorcycle deaths. But to the best of our knowledge there have been no attempts at assessing the impact of democratic regimes on road safety. The objective of our research, therefore, is to fill this gap by empirically analyzing the effect of democratic institutions on road safety, using multivariate models with country-level panel data. The rest of this paper seeks to answer the question: "What role is played by democratic political regimes, forms of government and electoral rules in shaping road safety outcomes?" Our results make a twofold contribution to the literature. First, they suggest that democratization does have an important and significant impact on the provision of road safety. Second, they show that road safety can be characterized as a local public good. These results have direct and sound policy implications everywhere, but are particularly relevant for developing countries due to their poorer road safety outcomes.

The rest of this paper is organized as follows. Section 2 reviews the literature on institutions as determinants of public policy outcomes. Section 3 examines the literature on road safety determinants. Our data, methodology and empirical models are presented in Section 4. The results are presented and discussed in Section 5. Finally, Section 6 concludes.

2. INSTITUTIONS AND PUBLIC GOOD PROVISION

The literature on economic policymaking analyzes the role played by political institutions in resolving conflicts among groups of voters and politicians. According to Myerson (1995), a political system's structure and related system of incentives determine political decisions and strategies, influencing government performance. As such, the policy outcomes of this policymaking process tend to be influenced by the prevailing political institutions.

Persson et al. (2000), for example, propose a public spending model for comparing presidential-congressional and parliamentary regimes and predict that presidential regimes produce smaller governments with inefficiently low spending on public goods. The empirical results corroborate that the size of government is smaller under presidential regimes. Persson and Tabellini's (2000) model is based on the trade-off a candidate faces when making a binding promise to supply a public good that benefits everyone ("universal" spending) or to target redistribution to a specific group or groups ("targetable" spending). The model predicts that parliamentary systems and proportional elections help produce spending programs that allocate revenues more evenly to broad and stable groups of the population. The model presented by Milesi-Ferretti et al. (2002) examines the trade-off that elected representatives face between allegiance to geographic constituencies and social constituencies, predicting that in proportional systems voters elect representatives prone to spending on transfers, while in majoritarian systems voters elect candidates prone to (local) public good spending. Their empirical results support the theoretical priors of the model. A further theoretical contribution is made by Lizzeri and Persico (2001), in whose politico-economic model office-seeking candidates face a trade-off between allocating public money to public goods or to pork-barrel projects. The model predicts that the proportional system is more efficient when the public good is very valuable and the winner-take-all system is more efficient when it is not very valuable. The empirical results of Persson and Tabellini (2003) suggest that presidential regimes have smaller governments than parliamentary regimes, and that majoritarian elections induce smaller governments, generate less welfare spending and smaller deficits than those resulting from proportional elections. Similar results are obtained in Persson and Tabellini (2004), who find that majoritarian elections lead to smaller governments and smaller welfare programs, while presidential regimes induce smaller governments than parliamentary democracies. Albalate, Bel, and Elias (2012) analyze the effect of democratization and the impact of electoral rule and form of government on national defense, finding that military spending is greater in presidential democracies with majoritarian electoral rule.

Another strand of the literature on political institutions compares the provision of public goods under authoritarian and democratic regimes. Mulligan et al. (2004) find no significant differences in policy outcomes in economically similar democracies and non-democracies. Stroup (2007) finds that governments with more democratic freedoms do not necessarily generate public policy that effectively provides public goods. However, the theoretical literature generally predicts that fewer resources are allocated to public good provision under dictatorial regimes than under democracies, and this is supported by the empirical papers. For instance, Lake and Baum (2001) construct and empirically test a theoretical model in which states are conceived as natural monopolies for public service provision and they find that fewer public services are provided under dictatorships. In the same vein, Deacon (2009) adapts a model of probabilistic voting to analyze the allocation of a government budget between a public good and transfers under dictatorship and democracy. Deacon's prediction that the level of public good provision is lower in dictatorships than in democracies is supported by results from his empirical analysis. Ghobarah, Huth, and Russett (2004) analyze the effect of political institutions on the level of public health expenditure and on health outcomes, finding that democracy is associated with higher total health spending. Profeta, Puglisi and Scabrosetti (2013) analyze the impact of democracy on military spending, finding an inverted U-shaped relationship between defense expenditure and the strength of democratic institutions. Finally, in the literature on the political economy of investment, Saiz (2006) finds that dictatorships invest more in road quality and quantity.

All in all, our literature review yields sound empirical evidence that the level of public good provision depends on a country's political institutions, making it reasonable to suppose that the provision of road safety as a public good will vary across countries governed by different political institutions. First, the literature suggests that authoritarian regimes provide fewer public goods, and we would therefore expect authoritarian countries to have poorer road safety outcomes. Second, presidential democracies with majoritarian electoral rule are found to have smaller governments and spend less on public goods than do parliamentary democracies with proportional electoral systems. We expect countries with presidential systems and majoritarian electoral rule to have higher numbers of traffic accidents and fatalities. We test these hypotheses with a multivariate model which controls for institutional variables and other road safety determinants. The following section reviews the literature on these factors.

3. RESEARCH ON ROAD SAFETY DETERMINANTS

Much of the academic work on road safety focuses on the effectiveness of road safety measures that neutralize and diminish the risk factors of traffic accidents, injuries and fatalities. Three main groups of measures – user-associated measures, concerned with road-user behavior; vehicle-related measures, aimed at improving vehicle safety; and road infrastructure-related measures – are commonly explored in the literature. The research concerned with road-user behavior and in-car safety analyzes the impact of traffic regulations and their enforcement, while the literature on road infrastructure-related measures assesses the effects of road characteristics and traffic conditions.

Among recent studies evaluating the implementation and enforcement of regulatory measures, many papers evaluate the effect of speed limit modification. They report mixed results and suggest that the effect of speed limit modifications is uneven and may be divergent for different groups of drivers (for example, see Dee & Sela, 2003; Tay, 2009). The effectiveness of seat belt laws is also extensively analyzed. Carpenter and Stehr (2008) and Cohen and Einav (2003) find that seat belt usage has a positive impact on road safety, while other papers (e.g., Derrig, Segui-Gomes, Abtahi, & Ling-Ling, 2002) find little or no evidence of safety belt effectiveness. The restrictive regulation of blood alcohol limits is generally found to be effective in improving road safety (see, amongst others, Albalate, 2008; Kaplan & Prato, 2007). This positive effect on road safety does not hold for the mandatory periodic motor vehicle inspection (see Christensen & Elvik, 2007; Sutter & Poitras, 2002).

Studies on the impact of road infrastructure usually report mixed results and seem to be dependent on particular cases and on the variables taken into account (Albalate et al., 2012). For instance, Anastasopoulos, Tarko, and Mannering (2008), Flahaut (2004), Park, Carlson, Porter, and

Andersen (2012), all find positive effects of better quality roads (broader lane-width, larger number of lanes, better paving, median strips and shoulders), while the results obtained by Noland (2003) undermine the hypothesis that improvements in road infrastructure effectively reduce fatalities and injuries. This divergence seems to be mostly due to the strength of the Peltzman effect (Peltzman, 1975), where drivers respond to improved safety measures by taking greater risks and so offset the effectiveness of the improved road infrastructure. Many studies (e.g., Haynes et al., 2008) also report that traffic conditions constitute an important determinant of road safety.

Another strand of literature on the determinants of road safety investigates the effect of socioeconomic variables. Some of these studies also consider the effect of institutions. For instance, the research by Jacobs and Cutting (1986) explores the relationship between the fatality rate and socio-economic and physical characteristics of developing countries such as per capita GDP, the number of circulating vehicles, road density, vehicle density, population per physician and population per hospital bed. It finds that the variable that has the greatest impact on the number of fatalities is vehicle ownership, and that per capita GDP, vehicle density and population per hospital bed are contributing factors.

In their research on the relationship between traffic fatalities and economic development, Anbarci et al. (2006) find that a decrease in public sector corruption reduces traffic deaths, and that the number of fatalities increases in income up to a threshold of US$15,000 and then decreases. These results are obtained for a cross-country panel data set where the variation in the number of road traffic fatalities is explained by the level of public sector corruption and other socio-economic variables (per capita GDP, illiteracy and fatality rates, motorization, population structure).

Another analysis of the effect of economic growth on traffic fatalities in low- and high-income countries is conducted in Bishai, Quresh, James, and Ghaffar (2006). The findings show that in low income countries per capita GDP growth is associated with an increase in traffic crashes, injuries and deaths, while in high income countries the increase in per capita GPD lowers the number of traffic fatalities but does not alter the number of crashes and injuries.

Law et al. (2009) also estimate the relationship between per capita income and traffic fatalities investigating the Kuznets curve relationship for motorcycle deaths. Using political rights and corruption indices as proxies for governance and the quality of political institutions, the authors find an inverted U-shaped relationship between motorcycle deaths and per capita income. They also find that the implementation of road safety regulations and the improvement of institutional quality, medical care and technology significantly reduce motorcycle deaths.

According to Grimm and Treibich (2010), the results of the inverted U-shaped relationship between income and traffic fatalities must be interpreted with caution. They suggest that income is a proxy for such factors as road network quality, the degree of motorization and the implementation and enforcement of regulations, and that it affects road safety through channel variables such as population and traffic density, risk-taking behavior or alcohol consumption. They find that the U-shaped relationship between income and road traffic fatalities does not hold when the effect of income on the variability of fatalities is disentangled from the effect of the channel variables. Neither does the effect of income seem significant in explaining the variation in fatalities within high- and low-income countries.

Vereeck and Vrolix (2007) also argue that per capita income must be treated as a complex indicator that comprises several factors: the average age of the vehicle fleet, road construction and maintenance, education level and economic conditions. Controlling for these factors and for traffic exposure, population characteristics and alcohol consumption, the authors explore how social willingness to comply with the law affects driver behavior and traffic fatalities. They find that social willingness to comply is an important factor and that this matters more to drivers than the content of the legal rule (legal specificity).

From this literature review we can conclude that there is a consensus on the set of factors that are most relevant to road safety: traffic exposure, road infrastructure characteristics, socio-economic variables, traffic regulation and driver behavior.[2] The aim of our research is to implement a model to predict cross-country road safety variability using these safety factors and a further set of explanatory variables associated with democratic institutions. To our knowledge, this is the first time this kind of modeling has been conducted.

4. DATA AND METHODOLOGY

To analyze the relationship between institutions and road safety we employ a panel of annual country data. The panel includes data for 138 countries over 35 years (1975-2009). These data comprise information on traffic fatalities, accidents with injuries, institutional variables and other controls (road network quality, traffic exposure and socio-economic variables). A summary of the descriptive statistics is provided in Table 1 and detailed information on our variables and data sources is given in Table 2. Unfortunately, the total number of observations in our analysis has been reduced, due to missing values, so we have to deal with an unbalanced data set.

<<Insert Tables 1, 2 about here >>

We employ Hausman's (Hausman, Bronwyn, & Griliches, 1984) negative binomial regression model, a specification that has been shown to yield a good fit for the analysis of count data, such as the number of traffic accidents and fatalities, and which has become the most frequently used specification in crash-frequency modeling (Lord & Mannering, 2010). Negative binomial estimators are more efficient than Poisson estimates because they control for the overdispersion commonly present in count data (Cameron & Trivedi, 2009). The descriptive statistics of our dependent variables reported in Table 3 show that the unconditional means of fatality and accident counts are much lower

[2] A detailed study of the effects of a range of different factors on road safety can be found in Bester (2000).

than their variance, which indicates the presence of overdispersion and suggests that the negative binomial model is an appropriate specification.

<<Insert Table 3 about here >>

The reasonable within- and between-variability of all the dependent variables (Table 3) facilitates the use of the conditional fixed-effects negative binomial model. This model allows for the correlation between common unobserved effects and the dependent variables, and overcomes the problem of omitted variable bias by collecting all the time-invariant information omitted in the fixed effects. The random-effects model may also be used, but it gives inconsistent estimates if shared unobserved effects are correlated with the regressors. In our analysis we employ both fixed- and random-effects specifications. The coefficient estimates obtained are consistently robust as regards their sign and, with some exceptions, their significance.

We estimate two models. Model 1 (Eq. 1) is employed for the full sample. Here we assess the effect of democratization on road safety. Model 2 (Eq. 2) is an extended model, in which we incorporate institutional variables that identify two specific traits of democracies: the electoral rule and the form of government. Model 2 is, therefore, estimated only for democratic countries and examines the effect of the traits of democracy on road safety.

$$Ln(\lambda_{it})=ln(vehkm_{it}) + \delta Leveldemoc_{it} + \beta X_{it} + TE_t + s_i + \varepsilon_{it} \quad (1)$$

$$Ln(\lambda_{it})=ln(vehkm_{it}) + \delta_1 Leveldemoc_{it} + \delta_2 Presidential_{it} + \delta_3 Major_{it} + \beta X_{it} + TE_t + s_i + \varepsilon_{it} \quad (2)$$

where i=1,…N; t=1….T_i

The dependent variable λ_{it} is the expected value of Y_{it} and $Var(Y_{it}) = \lambda_{it}\,(1+a_i)$ where a_i is the rate of overdispersion for each country. Y_{it} is either the number of traffic fatalities (*fat*) or the number of traffic accidents resulting in injuries (*accinj*). We implement these two variables to identify two dimensions of road safety: the severity of accidents captured by the fatality counts, and a broader measure captured by the number of accidents.

Eq. (1) is estimated for the full sample of countries and the institutional variable considered here is *leveldemoc*. It takes values from 1 to 7, where 1 is given to the least democratic countries and 7 to the most democratic countries[3]. Eq. (2) is estimated for democratic countries only (*leveldemoc* equal to 6 or 7) and, in addition to the *leveldemoc* institutional variable, the model employs *Presidential* and *Major* binary variables. These variables take a value of one, respectively, if the democracy is presidential and if the electoral rule is majoritarian. Otherwise, they take a value of zero.

Vector X_{it} collects (1) the time-varying controls related to the quality of the road network, i.e., the density of the road network (*density*), the share of motorways (*sharemw*) and the share of paved roads (*paved*)[4], and (2) the socio-economic time-varying controls, i.e., the logarithm of per capita GDP (*lgdppc*), the growth of per capita GDP (*grthgdppc*), the urban population concentration (*urbrate*) and the share of people over 65 years old (*pop65up*).

TE_t is a vector of variables related to time effects. First, we introduce a general time trend (*trend*) for all countries in order to account for the time patterns affecting road safety. Then, we replace the general trend with three different time trends: for low-income countries (*trendl*), middle-income countries (*trendm*) and high-income countries (*trendh*), to control for possible divergent time patterns between countries of different income levels. In the second model we introduce year-specific dummy variables for the first ten years following democratization to quantify the dynamics of the process.

N is the number of countries, T_i is the year for the *i*-th country and ε_{it} is the error term. In the fixed-effect specification s_i denotes either a country-specific fixed or random effect. The parameters

[3] See Table 2 for more information on how the *leveldemoc* variable is constructed

[4] Since the *sharemw* variable has more missing values than *paved*, we employ *paved* rather than *sharemw* in the second model (estimated only for democratic countries) to maintain a stable number of observations across the two models.

of the model are estimated by the maximum likelihood method. The number of vehicles per km network (*vehkm*) is an offset variable[5] accounting for the fact that countries with a higher level of motorization per network kilometer should have more traffic accidents and fatalities. In the estimation the coefficient of its logarithm is restricted to one.

5. RESULTS

First, we assess the effect of democratic institutions on traffic fatalities and accidents (Model 1). The results are displayed in Tables 4 and 5. Then, we assess the impact of two dimensions of democracy: the form of government and the electoral rule (Model 2). The results are shown in Tables 6 and 7. In each of these tables (4 through to 7), columns (1) and (2) display the results for fixed - and random-effects estimations without trend variables, while columns (3) to (4) and (5) to (6) show the results for fixed- and random-effects estimations with general trend and with three income-specific time trends, respectively. In Tables 6 and 7, columns (7) and (8) are added to show our results for the regressions with year-specific dummy variables for the first ten years after countries become democratic. The pairwise correlation coefficients for the variables with at least one correlation coefficient higher than 0.40 are reported in Table 8.[6]

<<Insert Tables 4, 5, 6, 7, 8 about here >>

[5] While traffic volume might be better as the offset, the variable available in the IRF's WRS database has a lot of missing values. We do not employ it in our final estimations, but we check the consistency of our results by estimating both models with the traffic volume offset variable. This modification does not substantially alter our original results.

[6] Two variables - *pop65up* and *trendh* - show high correlation coefficients. Nonetheless, the estimation of the Model (1) and (2) excluding these variables showed no significant alteration in coefficient estimates for other covariates, suggesting the absence of multicollinearity problem.

Institutional variables

As expected, democratic institutions have a marked impact on road safety. The coefficient estimates of the *leveldemoc* variable are negative across all regressions and statistically significant in all but one. The negative sign suggests that democracy has a positive effect on road safety.[7] This result is applicable not only to countries in a process of democratic transition but also to established democracies consolidating their democratic institutions. The results for the traffic accident counts in the estimation for the full sample are particularly notable because of the high significance (one percent) of all coefficients. This outcome is in line with the theoretical prediction that more democratic regimes are associated with higher levels of public good provision.

Our empirical results for the voting system show that the majoritarian voting rule has a positive effect on road safety, reducing the number of traffic fatalities. This can be interpreted using the model developed by Persson, Roland, and Tabellini (1999), which draws on the differentiation between systems of majoritarian and proportional representation based on district magnitude: under the proportional electoral system there is a single electoral district, while majoritarian systems use multiple-district elections. The difference in district magnitude across the two systems results in differences in public good provision: fiercer competition for the marginal district in majoritarian systems leads to smaller internalization of voter costs and benefits and, hence, to a lower level of public good provision than in proportional systems. A further theoretical result is offered by Milesi-Ferretti et al. (2002). In this model, the proportional system voters elect representatives whose spending satisfies a great variety of interests nationwide, while in majoritarian systems voters elect candidates committed to local public good spending. Consequently, one explanation for our empirical

[7] Instead of *leveldemoc* we also conduct the estimations with a binary variable which takes a value of one if the country is democratic and zero otherwise. The coefficient estimates obtained for this variable are statistically significant and negative, and its inclusion does not qualitatively alter the estimates for other regressors.

findings may be that voters consider road safety to be more properly a local public good, and give more incentives to increase its provision to politicians elected in majoritarian systems.

Our results for the form of government suggest that there are more traffic accidents in presidential than in parliamentary democracies. This confirms the prediction that presidential democracies provide lower levels of road safety as a public good than parliamentary democracies. The effect on traffic fatalities is not clear, since all but one coefficient estimates for the form of government are statistically non-significant.

Road infrastructure quality variables

The impact of road network density on both traffic fatalities and accidents is positive and statistically significant in the Model 1 estimation. The sign of the coefficient indicates that the number of traffic fatalities and accidents increases with increasing road density, since denser networks might mean that the greater supply of roads induces greater demand and, hence, more accidents. The effect is not evident in Model 2, where the coefficient estimates are mostly non-significant and, on occasions, negative and significant at the five and ten per cent levels.

The effect of the share of paved roads on road safety is beneficial: the sign of the coefficient estimates for both traffic fatalities and accidents is negative and statistically significant in both models. This result is largely intuitive since we expect a larger number of paved roads to enhance road safety.

The coefficient estimates for the share of motorways are positive and statistically significant in the estimation for traffic fatality counts. This suggests that a larger number of motorways has a negative effect on road safety, possibly because of the higher demand induced by a greater supply of better roads and because of the Peltzman effect (see explanation in Section 3 above). The estimations for the accident counts yield negative and statistically significant coefficients when time trends are not considered and positive and significant coefficients when the three income-specific trends are included. This may be explained by the significance of the time trends, which capture the improvement in road infrastructure technology.

Socio-economic variables

The concentration of population in urban areas displays a significant negative effect on road safety across both models. This result is consistent with the literature, which reports a higher relative risk of accidents with injuries in urban areas (Elvik et al., 2009). The increase in per capita GDP seems to have a negative effect on road safety by increasing the number of traffic fatalities. However, the coefficient is significant only in the regressions without time trends in Model 1 and without income-specific time trends in Model 2, which may be explained by higher rates of motorization leading to more traffic crashes and deaths in developing economies. The negative and statistically significant coefficient estimates for the income-specific control variable suggest that high income countries experience fewer accidents and fatalities from traffic crashes. The result for the elderly population control variable presents a positive sign in estimations for traffic accident counts. In the estimations for fatality counts without time trends the greater proportion of elderly people results in fewer fatalities. When the time trends are included, the coefficient estimates become either positive and statistically significant or non-significant. This change may be explained by the significance of the time trends, which capture the improvement in medical technology that is essential for the post-crash medical care associated with a smaller number of deaths caused by traffic accidents.

Trends and time effect variables

The general time trend and the trends for high- and middle-income countries are negative and statistically significant across both models. The negative signs of the coefficient suggest that growing public awareness of road safety and improvements in technology have a very clear and positive effect on road safety. This positive dynamic seems to occur only in high-income countries, since the coefficient estimates for the low-income countries are non-significant in the estimations for fatality counts and positively significant in the estimations for accident counts. The notable difference between the coefficient estimates associated with the time trends for middle- and high-income countries[8] supports the conclusion that the richer the country, the greater the rewards of improved road safety. In addition, the significance of the time trends may show that road safety benefits from other important factors not included in our regressions. This is important for our analysis, since we cannot rely on either regulation or enforcement variables. The favorable effect of traffic laws on road safety can be captured by significant time trends.

Interesting results are obtained for the timing effects of democratization on road safety. Our analysis is similar to analyses on democratic transitions and economic growth (Papaioannou & Siourounis, 2008), and to the literature assessing the lag in effectiveness of road safety regulations (e.g., Albalate, 2008; or Eisenberg, 2003). The dynamics of the timing effects are shown in Figures 3 and 4. They suggest that (1) a country's transition from autocratic to democratic regime leads to a decrease in the number of traffic fatalities and accidents; (2) there is a delay of four years before democratization starts to have a significant effect on road safety; (3) considering the sizes of coefficients, the impact of democratization becomes greatest in the sixth year of the country's transition.

<<Insert Figures 3, 4 about here >>

6. CONCLUSIONS

International institutions and national governments alike recognize that the deaths and injuries resulting from road traffic accidents are a major public health concern, above all in low- and

[8] Our tests find that the difference between coefficient estimates associated with the high- and middle-income trend variables is statistically significant.

middle-income countries. Although some of these losses are unavoidable, many are preventable. Today, reducing the burden of traffic accidents falls largely on the state authorities and, in this regard, governments can be seen as producers, and the general public as consumers, of road safety as a public good. Drawing on the results from the research on political institutions and economic policy, which indicate that public good provision varies systematically with the political institutions allocating public revenues, we argue that the level of provision of road safety is likewise influenced by the prevailing political institutions.

The descriptive statistics presented in the introduction to this paper and the results of our empirical study show that political institutions do play an important role in determining the toll of traffic accidents and fatalities. Above all, our results suggest that lower rates of fatalities and accidents are associated with democracies, and that the process of democratization has a beneficial and significant effect on road safety. Democratization would therefore seem to be an important process for stabilizing and then reducing the level of road traffic fatalities. However, we find that democratization does not have an immediate impact, it requiring around four years for its effects to start to become statistically noticeable. This suggests that democratic institutions need time to set up the bodies and implement the policies that produce better road safety outcomes. Yet, having said this, it is surprising just how quickly the effects become statistically significant. Interestingly, not only the beneficial effects of democratization apparent in countries making the transition to democracy, but they are also discernible in established democracies that are consolidating their political institutions.

The impact of democratic institutions on road safety is particularly significant in the low- and middle-income countries that were at the epicenter of the democratization process which took place in the last decades of the twentieth century. Yet, their performance in this area still leaves much to be desired. Reports issued by the international institutions claim that low- and middle-income countries continue to underperform on issues of road safety because of a lack of funding and political concern.

Indeed, even though the health costs attributable to road traffic injuries are comparable to those of malaria and tuberculosis, the fight against disease attracts greater political concern and financial support. Our characterization here of road safety as a local public good perhaps corroborates the evidence that it remains a secondary objective. In comparison, healthcare justifiably is given priority status, as low-income countries concentrate their efforts on disease prevention and eradication.

However, simply raising political awareness and increasing public spending on road safety are insufficient. If strong efficient institutions are not created, the general indifference to traffic laws and the authorities that enforce them can hamper effective outcomes. To understand more clearly the effect of these factors, future research needs to focus on the variables of regulation, enforcement and compliance. The consideration of road safety as the shared responsibility of governments and civil society suggests that social capital can also be a significant factor in this approach.

Overall, our research shows that the inclusion of institutional variables in the analysis of road safety determinants provides new insights in the analysis of traffic safety and the provisions of public goods. But if we are to alleviate the burden imposed by traffic accidents, especially in the world's poorest economies, we need a better understanding of the causal links between political institutions and road safety.

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FIGURES AND TABLES

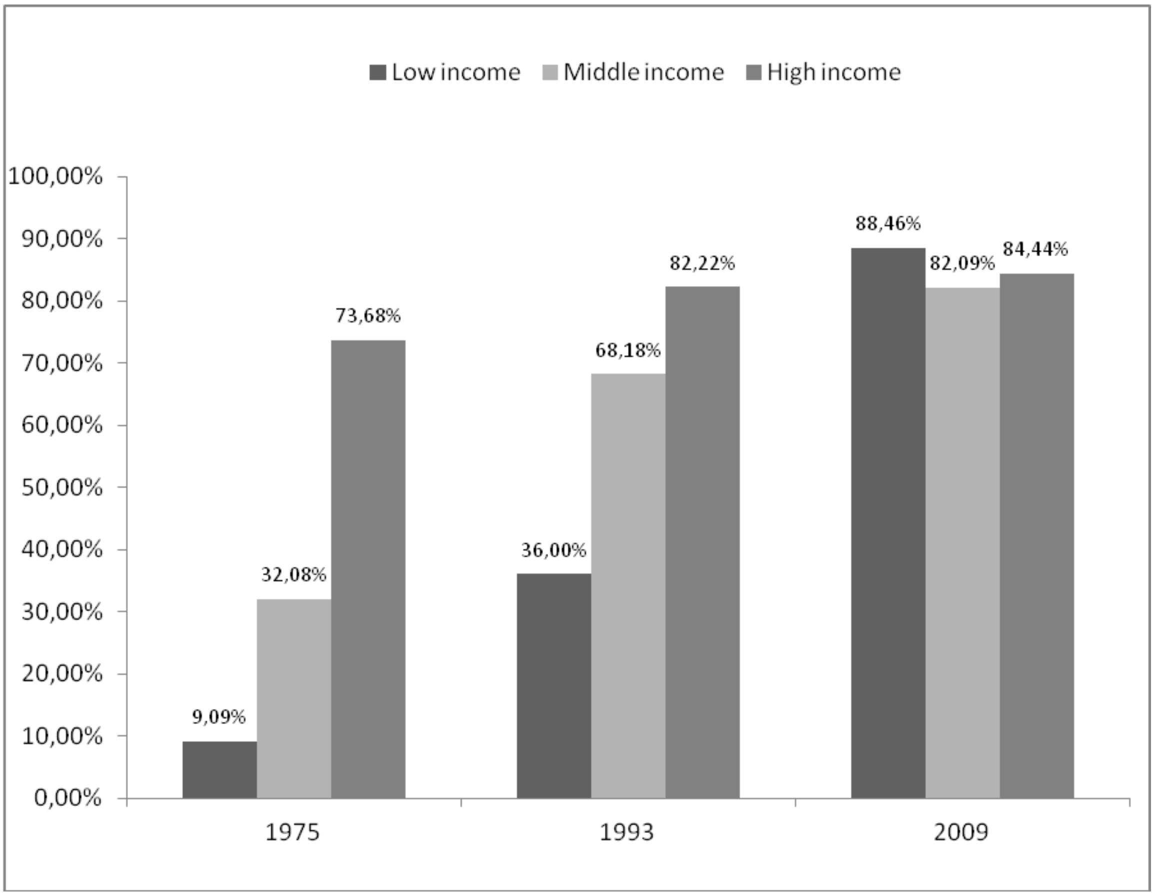

Figure 1. The share of democracies in 1975, 1993 and 2009 classified by income level.

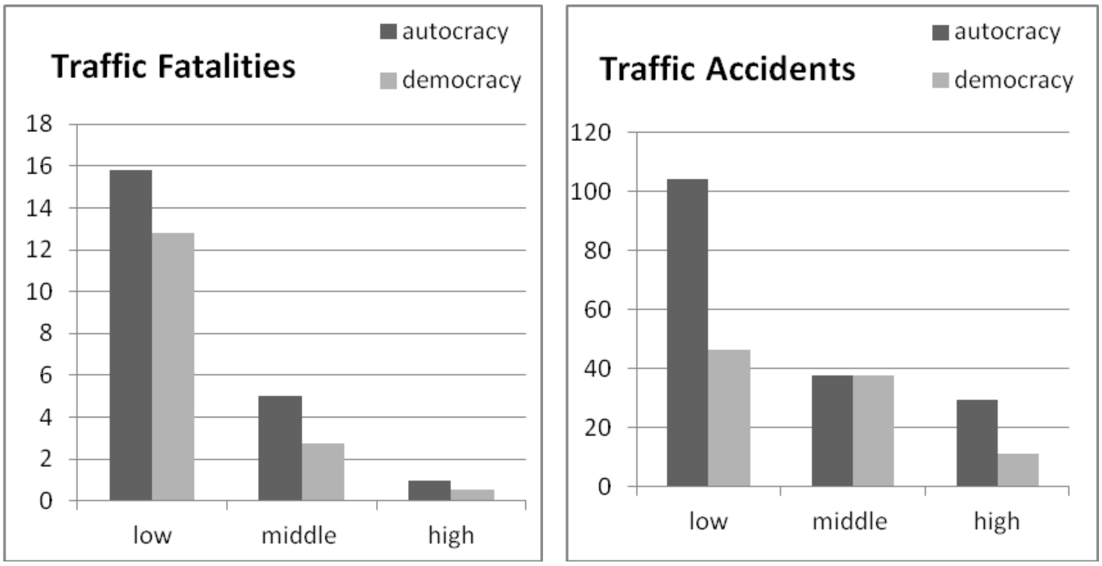

Figure 2. Traffic fatalities and accidents with injuries per vehicles x 1000, by regime type and income level. Average value 1975–2009.

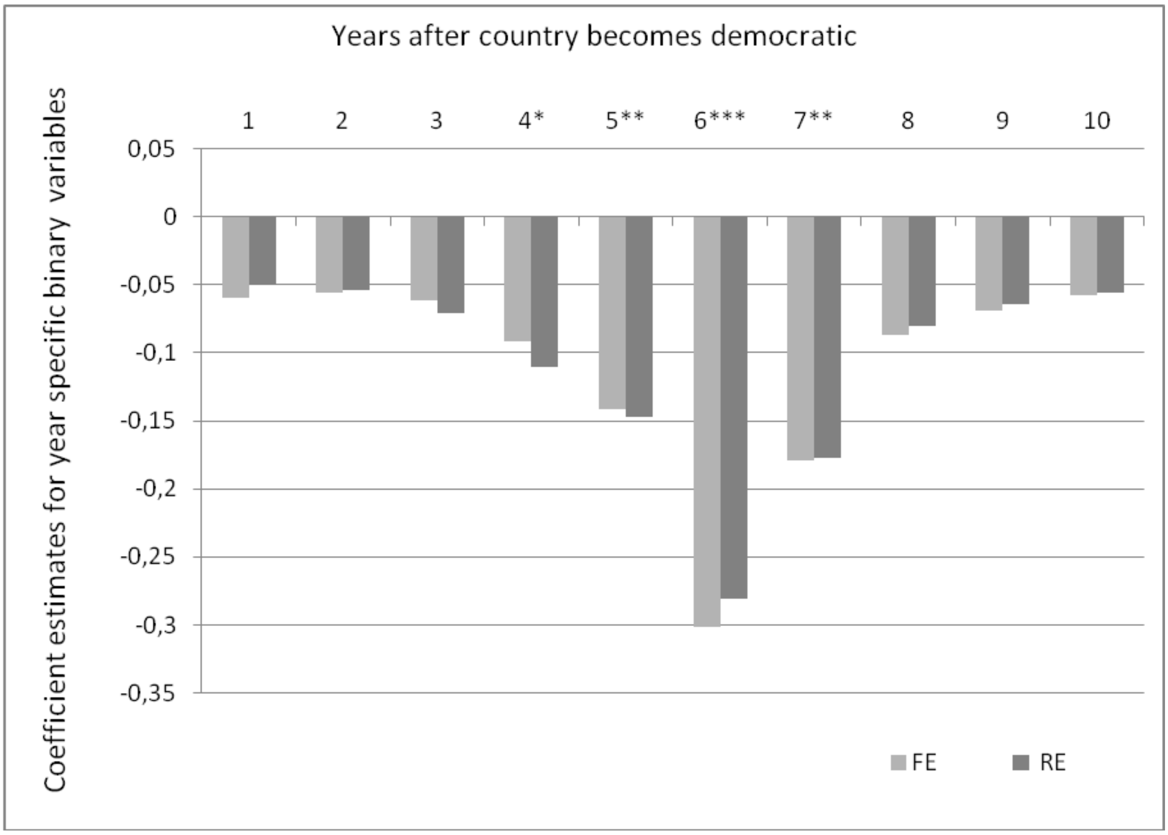

Figure 3. Timing effects. The impact of the first ten years of democracy on traffic fatality counts.
Note: *, ** and *** indicate the significance of the coefficient estimates. * p<0.05, ** p<0.01, *** p<0.001.

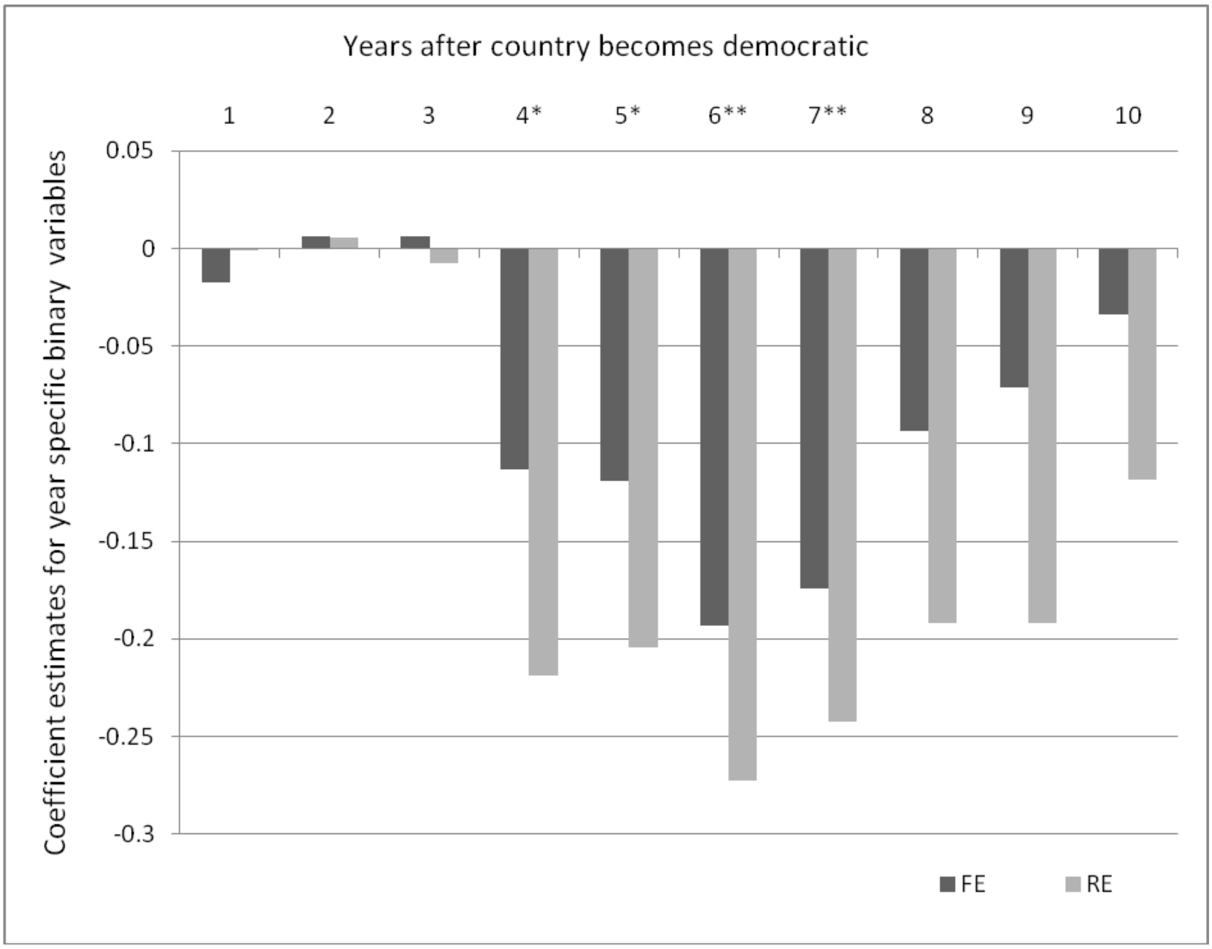

Figure 4. Timing effects. The impact of the first ten years of democracy on traffic accident counts (accidents with injuries).

Note: *, ** and *** indicate the significance of the coefficient estimates. * p<0.05, ** p<0.01, *** p<0.001.

Table 1. Sample statistics summary

Variable	Number observations	Mean	Std. Dev.	Min	Max
Dependent variables					
fat	2851	3876465	10426.6	4.5	125660
accinj	2659	75607.57	251039.5	85	2425054
Institutional variables					
leveldemoc	4462	5.286195	2.155548	1	7
presidential	4458	0.5361148	0.49875	0	1
major	3438	0.6614311	0.4732918	0	1
Infrastructure variables					
sharemw	1618	0.0172571	0.075184	0	1
density	2799	0.9109287	5.071533	0.005	256
paved	2633	52.29992	33.32716	0.15	100
Socio-economic controls					
lgdppc	4240	8.009008	1.624284	3.912867	11.38187
grthgdppc	4237	1.698487	6.123588	-50.23583	91.67289
pop65up	4830	6.906763	4.598957	0.3649629	22.28709
urbrate	4757	33.58355	18.46835	2.563864	100
Offset (exposure) variable					
vehkm	2424	28.94152	35.11312	0.05	429

Table 2. Definition of variables, definitions and data sources

Variable	Definition	Source
Dependent variables		
Fatalities	Number of deaths in road accidents	International Road Federation (IRF) World Road Statistics (WRS) 1963–1989, WRS 1990–1999 and WRS 2000–2010
Accidents	Number of road accidents with injuries	IRF WRS 1963–1989, WRS 1990–1999 and WRS 2000–2010
Institutional variables		
Level of democracy	Variable ranging from 1 (the most autocratic countries) to 7 (the most democratic countries)	Database of Political Institutions (Keefer, 2010). Constructed as equal to the Executive Index of Electoral Competitiveness (EIEC). A competitively elected prime-minister scores 6 or 7. If a chief executive receives less than 75% of the votes, the score is 7. If a chief executive receives more than 75% of the votes, the score is 6. A country is considered to be autocratic or a country where democratic institutions are not consolidated and leadership is personality-based if the EIEC is below 6.
Democracy	A dummy variable that takes a value of one if country is democratic and zero otherwise.	Database of Political Institutions and authors' own. Constructed from EIEC. If the EIEC is below 6, then the country is deemed autocratic or a country where democratic institutions are not consolidated and leadership is personality-based.
Democratization timing effects	A dummy variable that takes a value of one in a particular year after a country's democratization (only the first ten years are considered)	Database of Political Institutions and authors' own.
Presidential	A dummy variable that takes a value of one if the democracy is presidential and zero if it is parliamentary	Database of Political Institutions. Constructed from SYSTEM. As in Albalate et al. (2012), all assembly-elected president democracies are considered parliamentarian.
Majoritarian	A dummy variable that takes a value of one if the country has a majoritarian electoral rule and zero if the electoral rule is proportional.	Database of Political Institutions. Constructed from PLURALITY. In plurality systems, legislators are elected using a winner-take-all/first past the post rule. PLURALITY equals one if this system is used and zero otherwise.
Infrastructure		

variables		
Share motorways	Share of motorways over the total road network	IRF WRS 1963–1989, WRS 1990–1999 and WRS 2000–2010. Constructed as a ratio between the length of motorways and the length of the total road network.
Density	Density of total network (kms per sq. km)	IRF WRS 1963–1989, WRS 1990–1999 and WRS 2000–2010
Paved	Percentage of paved roads over the total road network	IRF WRS 1963–1989, WRS 1990–1999 and WRS 2000–2010
Socio-economic controls		
LGDP per capita	Natural logarithm of GDP per capita (constant 2005 US$)	WDI database (World Bank, 2012) and authors' own
Growth GDP per capita	GDP per capita growth (annual %)	WDI database
Population over 65	Share of population older than 65	WDI database
Urban concentration of population	Population in the largest city as a percentage of urban population	WDI database
Exposure variable		
Vehicles per km	Units of vehicles per km of road network	IRF WRS 1963–1989, WRS 1990–1999 and WRS 2000–2010
Other variables		
Trend	A variable that captures the effects of time. It takes a value of one for the first year in the sample (1975) and increases by one for each passing year.	Authors' own
Trend low income countries	A variable that takes a value of one for the first year in the sample (1975) and increases by one for each passing year for low income countries only.	IRF WRS 2000–2010 and authors' own. Countries considered are classified as "low income" in IRF WRS 2000–2010.
Trend middle income countries	A variable that takes a value of one for the first year in the	IRF WRS 2000–2010 and authors' own. Countries considered are classified as "lower middle income"

	sample (1975) and increases by one for each passing year for middle income countries only.	and “upper middle income” in IRF WRS 2000–2010.
Trend high income countries	A variable that takes a value of one for the first year in the sample (1975) and increases by one for each passing year for high income countries only.	IRF WRS 2000–2010 and authors' own. Countries considered are classified as “high income” in IRF WRS 2000–2010.

Table 3. Variability and overdispersion. Dependent variables and institutional variables

Variable		Mean	Std. Dev.	Min	Max	Observations
fat	overall	3876.47	10426.60	4.50	125660.00	N = 2851
	between		9083.45	17.06	71727.44	n = 138
	within		4210.34	-49969.13	57809.03	T-bar = 20.6594
accinj	overall	75607.57	251039.5	85	2425054	N = 2659
	between		190720.7	111	2051122	n=138
	within		44236.56	-427717.1	555720.6	T-bar=19.681
leveldemoc	overall	5.29	2.16	1	7	N = 4462
	between		1.67	2	7	n = 138
	within		0.35	0.43	1.,20	T-bar = 32.3333
presidential	overall	0.54	0.50	0	1	N = 4458
	between		0.46	0	1	n = 138
	within		0.20	-0.41	1.45	T-bar = 32.3043
major	overall	0.66	0.47	0	1	N = 3438
	between		0.43	0	1	n = 132
	within		0.18	-0.31	1.63	T-bar = 26.0455

Note: The overall and within statistics are calculated over N country-years of data. The between standard deviation is calculated over n countries. The average number of years each country was observed during T-bar years.

Table 4. Results: Negative binomial estimates for fatality counts. Full sample

	(1)	(2)	(3)	(4)	(5)	(6)
	fatfe1	fatre1	fatfe2	fatre2	fatfe3	fatre3
Institutional variables						
leveldemoc	-0.0333*	-0.0317*	-0.0360**	-0.0392**	-0.0432**	-0.0449***
	(0.0143)	(0.0141)	(0.0135)	(0.0131)	(0.0133)	(0.0130)
Infrastructure variables						
sharemw	1.8540***	1.8178***	1.5199***	1.5111***	1.7247***	1.6997***
	(0.2407)	(0.2461)	(0.2983)	(0.2942)	(0.2671)	(0.2650)
density	0.1542***	0.1228***	0.2560***	0.2148***	0.3028***	0.2626***
	(0.0220)	(0.0234)	(0.0217)	(0.0221)	(0.0224)	(0.0229)
Socio-economic controls						
grthgdppc	0.0050*	0.0054*	0.0034	0.0042	0.0003	0.0011
	(0.0023)	(0.0023)	(0.0024)	(0.0024)	(0.0024)	(0.0024)
lgdppc	-0.4804***	-0.5084***	-0.2570***	-0.3331***	-0.1384**	-0.2157***
	(0.0350)	(0.0343)	(0.0423)	(0.0403)	(0.0468)	(0.0453)
urbrate	0.0225***	0.0185***	0.0165***	0.0113***	0.0192***	0.0143***
	(0.0024)	(0.0024)	(0.0027)	(0.0027)	(0.0026)	(0.0027)
pop65up	-0.0727***	-0.0675***	0.0226**	0.0236**	0.0270***	0.0295***
	(0.0091)	(0.0090)	(0.0086)	(0.0087)	(0.0081)	(0.0082)
Time trends						
trend			-0.0343***	-0.0323***		
			(0.0018)	(0.0017)		
trendl					0.0064	0.0059
					(0.0042)	(0.0040)
trendm					-0.0262***	-0.0256***
					(0.0026)	(0.0026)
trendh					-0.0410***	-0.0393***
					(0.0019)	(0.0019)
N	1143	1157	1143	1157	1143	1157
AIC	16.227	18.491	15.869	18.216	15.925	18.197
chi2	1306	1245	1927	1834.0201	2059.7147	1956.7946
ll	-8105.3	-9235.5	-7925.4	-9063.6175	-7897.8345	-9036.3352

Notes: Cluster-robust standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001; N: number of observations; AIC: Akaike information criteria; chi2: Wald test statistic; ll: log likelyhood.

Table 5. Results: Negative binomial estimates for accident counts (accidents with injuries). Full sample

	(1)	(2)	(3)	(4)	(5)	(6)
	accfe1	accre1	accfe2	accre2	accfe3	accre3
Institutional variables						
leveldemoc	-0.0743***	-0.0768***	-0.0584***	-0.0639***	-0.0523***	-0.0574***
	(0.0173)	(0.0169)	(0.0154)	(0.0151)	(0.0157)	(0.0154)
Infrastructure variables						
sharemw	-6.7891***	-6.3538***	0.2262	0.5233	1.1632*	1.2085**
	-15.478	-15.382	(0.9380)	(0.7349)	(0.4755)	(0.4457)
density	0.1852***	0.1146***	0.2979***	0.2399***	0.3020***	0.2497***
	(0.0273)	(0.0298)	(0.0233)	(0.0253)	(0.0236)	(0.0251)
Socio-economic controls						
grthgdppc	0.0012	0.0017	-0.0010	0.0010	-0.0019	-0.0004
	(0.0028)	(0.0030)	(0.0025)	(0.0027)	(0.0025)	(0.0026)
lgdppc	-0.3549***	-0.3626***	-0.2381***	-0.2979***	-0.2066***	-0.2444***
	(0.0425)	(0.0426)	(0.0469)	(0.0460)	(0.0482)	(0.0487)
urbrate	0.0163***	0.0110***	0.0210***	0.0167***	0.0207***	0.0169***
	(0.0026)	(0.0027)	(0.0022)	(0.0025)	(0.0022)	(0.0024)
pop65up	0.0173*	0.0219**	0.0958***	0.0965***	0.0917***	0.0908***
	(0.0085)	(0.0085)	(0.0079)	(0.0081)	(0.0080)	(0.0082)
Time trends						
trend			-0.0322***	-0.0303***		
			(0.0016)	(0.0016)		
trendl					0.0274***	0.0266***
					(0.0056)	(0.0053)
trendm					-0.0426***	-0.0409***
					(0.0036)	(0.0034)
trendh					-0.0329***	-0.0313***
					(0.0019)	(0.0019)
N	1110	1123	1110	1123	1110	1123
AIC	21.994	24.659	21.675	24.380	21.646	24.346
chi2	299	241	946	741	959	776
ll	-10990.00	-12320.00	-10830.00	-12180.00	-10810.00	-12160.00

Notes: Cluster-robust standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001; N: number of observations; AIC: Akaike information criteria; chi2: Wald test statistic; ll: log likelyhood.

Table 6. Results: Negative binomial estimates for fatality counts. Democracies only

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	fatfe1	fatre1	fatfe2	fatre2	fatfe3	fatre3	fatfe4	fatre4
Institutional variables								
leveldemoc	-0.1209*	-0.1336*	-0.1243*	-0.1272*	-0.1803**	-0.1861**	-0.1580*	-0.1657**
	(0.0561)	(0.0553)	(0.0605)	(0.0590)	(0.0634)	(0.0617)	(0.0640)	(0.0623)
major	-0.6293***	-0.5999***	-0.6696***	-0.6286***	-0.6241***	-0.5730***	-0.6438***	-0.5847***
	(0.0631)	(0.0606)	(0.0621)	(0.0596)	(0.0630)	(0.0608)	(0.0637)	(0.0616)
presidential	-0.1129*	-0.0912	0.0043	0.0319	0.0100	0.0399	-0.0032	0.0228
	(0.0479)	(0.0480)	(0.0464)	(0.0471)	(0.0474)	(0.0480)	(0.0472)	(0.0482)
Infrastructure variables								
paved	-0.0051***	-0.0054***	-0.0027*	-0.0031**	-0.0029**	-0.0032**	-0.0033**	-0.0036***
	(0.0011)	(0.0011)	(0.0011)	(0.0010)	(0.0011)	(0.0010)	(0.0010)	(0.0010)
density	-0.0260*	-0.0342**	-0.0294*	-0.0387**	-0.0203	-0.0294*	-0.0151	-0.0256*
	(0.0114)	(0.0119)	(0.0115)	(0.0119)	(0.0114)	(0.0118)	(0.0114)	(0.0116)
Socio-economic controls								
grthgdppc	0.0071*	0.0073**	0.0059*	0.0066*	0.0044	0.0050	0.0033	0.0043
	(0.0028)	(0.0028)	(0.0026)	(0.0026)	(0.0026)	(0.0026)	(0.0026)	(0.0026)
lgdppc	-0.3067***	-0.3509***	-0.2099***	-0.2771***	-0.1067*	-0.1703***	-0.1097*	-0.1756***
	(0.0366)	(0.0355)	(0.0381)	(0.0369)	(0.0447)	(0.0429)	(0.0454)	(0.0433)
urbrate	0.0133***	0.0077**	0.0180***	0.0119***	0.0187***	0.0124***	0.0200***	0.0134***
	(0.0025)	(0.0026)	(0.0025)	(0.0026)	(0.0025)	(0.0026)	(0.0026)	(0.0026)
pop65up	-0.0793***	-0.0690***	-0.0067	-0.0016	-0.0040	0.0021	-0.0008	0.0048
	(0.0111)	(0.0109)	(0.0109)	(0.0109)	(0.0107)	(0.0107)	(0.0105)	(0.0104)
Time trends								
trend			-0.0236***	-0.0223***				
			(0.0017)	(0.0017)				
trendl					0.0030	0.0040	0.0003	0.0015
					(0.0041)	(0.0038)	(0.0041)	(0.0039)
trendm					-0.0182***	-0.0174***	-0.0186***	-0.0180***
					(0.0026)	(0.0025)	(0.0025)	(0.0025)
trendh					-0.0287***	-0.0281***	-0.0300***	-0.0293***
					(0.0019)	(0.0020)	(0.0019)	(0.0019)
Democratization timing effects	No	No	No	No	No	No	Yes	Yes
N	1190	1198	1190	1198	1190	1198	1190	1198
AIC	16.133	18.385	15.959	18.230	15.941	18.209	15.921	18.192
chi2	937	970	1204	1158	1220	1160	1351	1274
ll	-8057	-9181	-7969	-9102	-7958	-9089	-7938	-9071

Notes: Cluster-robust standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001; N: number of observations; AIC: Akaike information criteria; chi2: Wald test statistic; ll: log likelyhood.

Table 7. Results: Negative binomial estimates for accident counts (accidents with injuries). Democracies only

	(1) accfe1	(2) accre1	(3) accfe2	(4) accre2	(5) accfe3	(6) accre3	(7) accfe4	(8) accre4
Institutional variables								
leveldemoc	-0.1638*	-0.1903**	-0.1367	-0.1645*	-0.1707*	-0.2045**	-0.1534*	-0.1839*
	(0.0723)	(0.0721)	(0.0731)	(0.0734)	(0.0768)	(0.0769)	(0.0777)	(0.0779)
major	-0.4234***	-0.3770***	-0.3702***	-0.3266***	-0.3124***	-0.2632***	-0.3265***	-0.2718***
	(0.0625)	(0.0612)	(0.0615)	(0.0601)	(0.0628)	(0.0612)	(0.0632)	(0.0614)
presidential	0.1309*	0.1250*	0.2486***	0.2500***	0.2379***	0.2360***	0.2286***	0.2248***
	(0.0539)	(0.0542)	(0.0526)	(0.0533)	(0.0531)	(0.0537)	(0.0534)	(0.0542)
Infrastructure variables								
paved	-0.0077***	-0.0081***	-0.0046***	-0.0051***	-0.0040***	-0.0044***	-0.0045***	-0.0047***
	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
density	0.0034	-0.0112	0.0113	-0.0038	0.0127	-0.0020	0.0107	-0.0058
	(0.0147)	(0.0155)	(0.0132)	(0.0138)	(0.0133)	(0.0139)	(0.0136)	(0.0142)
Socio-economic controls								
grthgdppc	0.0036	0.0043	0.0026	0.0038	0.0019	0.0029	0.0014	0.0028
	(0.0029)	(0.0030)	(0.0028)	(0.0028)	(0.0028)	(0.0029)	(0.0028)	(0.0029)
lgdppc	-0.3947***	-0.3892***	-0.2975***	-0.3157***	-0.2133***	-0.2193***	-0.2419***	-0.2488***
	(0.0374)	(0.0370)	(0.0390)	(0.0382)	(0.0474)	(0.0466)	(0.0488)	(0.0476)
urbrate	0.0228***	0.0183***	0.0253***	0.0204***	0.0249***	0.0200***	0.0251***	0.0200***
	(0.0024)	(0.0025)	(0.0024)	(0.0025)	(0.0023)	(0.0024)	(0.0024)	(0.0025)
pop65up	0.0632***	0.0624***	0.1095***	0.1070***	0.1054***	0.1022***	0.1091***	0.1057***
	(0.0093)	(0.0092)	(0.0090)	(0.0091)	(0.0092)	(0.0093)	(0.0093)	(0.0094)
Time trends								
trend			-0.0228***	-0.0219***				
			(0.0017)	(0.0017)				
trendl					0.0146**	0.0165***	0.0124**	0.0142**
					(0.0045)	(0.0044)	(0.0046)	(0.0044)
trendm					-0.0293***	-0.0296***	-0.0291***	-0.0297***
					(0.0033)	(0.0032)	(0.0033)	(0.0032)
trendh					-0.0251***	-0.0245***	-0.0253***	-0.0247***
					(0.0020)	(0.0020)	(0.0020)	(0.0020)
Democratization timing effects	No	No	No	No	No	No	Yes	Yes
N	1153	1160	1153	1160	1153	1160	1153	1160
AIC	22.088	24.782	21.933	24.642	21.914	24.617	21.911	24.613
chi2	402	377	608	544	629	573	670	612
ll	-1103.00	-1238.00	-1096.00	-1231.00	-1094.00	-1229.00	-1093.00	-1228.00

Notes: Cluster-robust standard errors in parentheses; * p<0.05. ** p<0.01. *** p<0.001; N: number of observations; AIC: Akaike information criteria; chi2: Wald test statistic; ll: log likelyhood.

Table 8. Correlation matrix[1]

	presidential	pop65up	lgdppc	paved	trend	trendh	trendm	trendl
presidential	1.00							
pop65up	-0.51	1.00						
lgdppc	-0.41	0.72	1.00					
paved	-0.38	0.60	0.56	1.00				
trend	0.02	0.19	0.11	0.16	1.00			
trendh	-0.36	0.63	0.72	0.47	0.39	1.00		
trendm	0.26	-0.25	-0.28	-0.10	0.38	-0.51	1.00	
trendl	0.32	-0.44	-0.67	-0.31	0.30	-0.46	0.39	1.00

[1] variables with correlation coefficients greater than 0.4