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Can cars and trucks coexist peacefully on highways? Analyzing the effectiveness of road safety policies in Europe

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ABSTRACT

We examine the impact on the traffic accident rate of the interaction between trucks and cars on Europe's roads using a panel data set that covers the period 1999–2010. We find that rising motorization rates for trucks lead to higher traffic fatalities, while rising motorization rates for cars do not. Empirically, the model we build predicts the positive impact of stricter speed limit legislation for trucks in the reduction of road fatalities. These findings lend support to European strategies and aimed at promoting alternative modes of freight transport, including rail and maritime transport.

1. Introduction

According to Baindur and Viegas (2011), from 2004 to 2013 the European Union (EU) experienced significant growth in road freight transport of about 60%, adding 20.5 billion tonne-kilometres per year across the EU25 States. According to the European Commission (2013a), in 2011 total goods transport activities in the EU27 amounted to 3824 billion tonne-kilometres. Most freight is transported by road, accounting for 45.3% of this total, compared to 11% rail, 3.7% inland waterways and 3.1% oil pipelines, albeit with differences from one state to another (see for example, Castillo-Manzano et al., 2013, for a broad consideration of rail–truck freight transport modal distribution).

Consequently, truck operations have recently become an important focus of academic research, not only because road freight transport is the backbone of logistics, but because trucks are associated with negative externalities, including pollution, congestion and accidents (Rowangould, 2013). While the negative environmental impacts of truck operations have been extensively analyzed, comparatively little attention has been paid to the role of trucks in road accidents (Kim and Van Wee, 2014) despite the fact that, according to the EU-OSHA (European Agency for Safety and Health at Work, 2010), transportation vehicle-related accidents are the second largest cause of fatal crashes, and around a third of the deaths in EU workplace accidents are linked to transport.

To date, the relevant literature that has analyzed accidents related to truck–traffic safety issues has mainly focused on the frequency of accidents and identifying determinants (Cantor et al., 2010; Häkkänen and Summala, 2001). Special attention has been paid to the variables that explain accident severity (Chang and Chien, 2013; Lemp, 2011; Zhu and Sirnivasan, 2011) and the strategies that might be effective for prevention (see the review by Mooren et al., 2014); risk factors associated with truck driver behavior, including cell phone use, fatigue and drowsiness, alcohol and drug consumption (Loeb and Clarke, 2007); truck characteristics (dimensions and weights) and technical facilities (roadway types, electronic stability programs) to improve performance of vehicle maneuvering (Mooren et al., 2014); interaction between trucks and other vehicles on roads; rural and urban settings (Chen and Chen, 2011; Gabler and Hollowell, 2000; Harwood et al., 2003; Peeta et al., 2004; Summala and Mikkola, 1994); and the characteristics of heavy and large trucks (Ortega et al., 2014).

Another area of study addresses safety issues regarding differential treatment applied to trucks as a consequence of the peculiar characteristics of these vehicles and their traffic operations (a greater truck mass, weight and dimensions; nighttime and commercial driving schedules) which further increase risk to traffic safety in general (see Choi et al., 2014, for a specification, and Cherry and Adelakun, 2012, for an examination of truck drivers' perceptions). Certain strategies have been developed to mitigate these aspects; separating trucks and facilitating their maneuvers

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(such as lane operations, and differential road safety policies, such as speed limits by vehicle type; specific enforcement) although there seem to have been comparatively few studies evaluating their effectiveness (Cate and Urbanik, 2004; El-Tantawy et al., 2009; Neeley and Richardson, 2009; Qi et al., 2012). In this line, most previous research has explored the characteristics of accidents and associated risks when larger trucks are involved (Chang and Chien, 2013; Dong et al., 2014; Lemp et al., 2011; Zhu and Srinivasan, 2011, among many others).

This paper focuses on the complex nature of the coexistence of trucks and passenger cars by drawing on a panel data set for European countries. Applying econometric techniques to a panel data from EU countries for the period 1999–2010, we examine whether greater numbers of trucks and cars per capita on the roads have positive or negative impacts on road safety. We also assess the efficacy of two regulations for trucks, not harmonized as yet in the EU, namely, speed limits and maximum blood alcohol concentration (BAC) rates. For this, the article is divided into the following sections: apart from Section 1, Section 2 describes the data and variables, and defines the methodology, Section 3 presents the resulting estimates, Section 4 lays out the appropriate discussion; and finally, Section 5 offers a set of concluding remarks with policy implications within the current EU transport policy framework.

2. Empirical approach

We estimate a model that takes the following form for country *i* during period *t*:

$$Y_{it} = \alpha + \beta_k X_{it} + \gamma_k Z_{it} + \lambda_k W_{it} + \mu_i + \nu_t + \varepsilon_{it} \quad (1)$$

where Y_{it} is a variable that indicates the number of total fatalities (within 30 days of the accident, according to the Vienna Convention definition), X_{it} contains the vector of the country's economic and demographic attributes, Z_{it} refers to variables that identify the motorization rates for trucks (i.e., number of trucks per capita; in their entirety, with no distinction in terms of weight and size) and motorization rates for passenger cars (i.e., number of passenger cars per capita), and W_{it} are specific variables related to road safety policies. μ_i are country fixed effects that control for omitted time-invariant country-specific variables, ν_t are year dummies that control for the common trend in all the countries in the dataset and ε_{it} is a mean-zero random error.

The data used are for the EU-28 countries from 1999 to 2010. Table 1 provides a description of the variables and the data sources, the unit of observation being the country-year pair. The explanatory variables include factors typically examined in road safety studies (see for example, Dee and Sela, 2003; Albalate and Bel, 2012).

Per capita GDP is included as an explanatory variable to test for a possible relationship between economic development and road traffic fatalities (Kopits and Cropper, 2005). It is not clear what the sign of the coefficient associated with this variable should be, a priori. On the one hand, traffic fatality rates may increase with economic development in poorer countries, due to increased exposure to road traffic fatalities. On the other hand, the relationship between economic development and traffic fatality rates may become flat or even reverse after a certain wealth threshold has been reached (Bishai et al., 2006).

The influence of the quality of the transport infrastructure is also considered with the inclusion of a motorway density variable. In this regard, a negative relationship is expected between the quality of transport infrastructure and road traffic fatality rates (Noland, 2003).

Furthermore, two control variables are included relating to the percentage of vulnerable population in the country (Langford et al., 2006; Braver and Trempel, 2004). The first variable is for the population over 60 years old. Indeed, the impact of accidents may be higher for older road users as morbidity and mortality are higher for older populations (see Yee et al., 2006).

The second variable considered is for the percentage of population aged from 20 to 39 years. This wide 20–39 age range enables the capture of the relevant sociological changes that have taken place in the young driver's profile in many developed countries in recent years that have led to a sharp decline in the numbers of young people gaining driving licenses and owning cars (see the systematic literature review on this topic by Delbosc and Currie, 2013). Borrell et al. (2005) conclude in this respect that the youth group between 20 and 39 years is an important risk group contributing to fatal traffic accidents.

One of the innovative contributions of the analysis lies in the distinction drawn between two motorization rates: the number of trucks per capita and the number of passenger cars per capita. In this regard, a country's aggregate level of motorization is usually taken into account in studies on the determinants of road traffic fatalities (Albalate, 2008; Albalate and Bel, 2012; Kopits and Cropper, 2005). It is not clear what relationship with road traffic fatalities should be expected. On the one hand, higher levels of motorization may imply higher exposure to road traffic accidents. On the other hand, more developed countries may enjoy better infrastructure and vehicles, more advanced policies and more beneficial social attitudes towards road safety (such as major post-accident medical care, see Castillo-Manzano et al., 2014a). In our

Table 1
Variables used in the empirical analysis.

Variables	Description	Source
Fatalities	Number of traffic fatalities	CARE (EU road accidents database)
Motorization_trucks (per capita)	Number of trucks (irrespective of weights and dimensions)/1000 inhabitants	UNECE, EUROSTAT (for population)
Motorization_cars (per capita)	Number of registered passenger cars/1000 inhabitants	UNECE, EUROSTAT (for population)
Per capita GDP	Per capita Gross Domestic Product in International Comparable Prices (US$ at 2005 prices and PPP)	EUROSTAT
Motorway density	Number kms of motorways divided by km^2 of the country	UNECE, EUROSTAT
Old	% population over 60 years old	EUROSTAT
Young	% population aged 20–39 years	EUROSTAT
BAC_05, BAC_05_professional	Dummy variables that takes a value of 1 where the maximum BAC rate allowed for conventional car drivers or professional drivers is less than 0.5 g/l	European Commission Road Safety Website
Penalty_system, Demerit_System	Dummy variables that takes the value 1 if the penalty system driving license is applied or if the demerit system driving license is applied	European Transport Safety Council (ETSC)
Speed limits	Maximum speed limits for cars and heavy good vehicles – over 3.5 t (km/h)	European Commission Road Safety Website