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When may road fatalities start to decrease?

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ABSTRACT

Introduction: The comparative analysis of macroscopic trends in road safety has been a popular research topic. The objective of this research is to propose a simple and, at the same time, reliable multiple regime model framework for international road safety comparisons, allowing for the identification of slope changes of personal risk curves and respective breakpoints. *Method:* The trends of road traffic fatalities in several EU countries have been examined through the temporal evolution of elementary socioeconomic indicators, namely motorized vehicle fleet and population, at the country level. *Results:* Piece-wise linear regression models have been fitted, using a methodology that allows the simultaneous estimation of all slopes and breakpoints. The number and location of breakpoints, as well as the slope of the connecting trends, vary among countries, thus indicating different road safety evolution patterns. *Impact on industry:* Macroscopic analysis of road accident trends may be proved beneficial for the identification of best examples and the implementation of appropriate programmes and measures, which will lead to important benefits for the society and the economy through the reduction of road fatalities and injuries. Best performing countries and the related programmes and measures adopted may concern several safety improvements at the processes of the road, the vehicle and the insurance industries. *Conclusions:* Lessons from the analysis of the past road safety patterns of developed countries provide some insight into the underlying process that relates motorization levels with personal risk and can prove to be beneficial for predicting the road safety evolution of developing countries that may have not yet reached the same breakpoints. Furthermore, the presented framework may serve as a basis to build more elaborate models, including more reliable exposure indicators (such as vehicle-km driven).

1. Introduction

The comparative analysis of macroscopic trends in road-safety-related issues among countries and regions has attracted the attention of researchers for several decades. A critical review of a number of approaches for modeling road safety trends can be found in Hakim, Shefer, Hakkert, and Hocherman (1991) and Oppe (1989). Al-Haji (2007) provides a review of these concerns, as well as several alternative approaches for the development of road safety models. Other useful reviews are provided by the COST329 group (2004) and Broughton (1991), where a detailed analysis of the debate surrounding Smeed's formulas and analysis (Smeed, 1968) is available.

In recent years, some interesting approaches have been presented on the topic. Lassarre (2001) presented an analysis of the progress of 10 European countries in road safety by means of a structural (local linear trend) model, yielding two adjusted trends, one deterministic, and one stochastic. This was achieved through incorporation of intervention functions related to the major road safety measures introduced. An indicator of the rate of progress, taking into account risk exposure trends (vehicle-km travelled), was defined. It was deduced that all major EU countries exhibit a rate of progress above a minimum threshold of 4.5% annually. The average of 6% is equivalent to the statement that the road transport system in Europe "is capable of absorbing a 6% increase in traffic at a constant number of fatalities."

Page (2001) presented an exponential formula that yields fatalities as the product of all explanatory variables' influence. This function is easily transformed to a simple algebraic form (first order polynomial with an intercept) by taking the logarithm of both sides. The objective of this research is based on safety level comparison among selected OECD countries during the period 1980-1994. Taken that fatality rates are not sufficient to perform international comparisons, a statistical multiple regression tool was set up. The model assumes that each variable's effect is independent of its original level, implying constant elasticity. Interestingly, the negative intercept represents a positive mean effect of missing variables on safety.

Models with several exogenous variables are developed and attempts to rank countries based on their road mortality level were made. Beenstock and Gafni (2000) show that there is a relationship between the downward trend in the rate of road accidents in Israel and other countries and suggests that this reflects the international propagation of road safety technology as it is embodied in motor vehicles and road design, rather than parochial road safety

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policy. van Beeck, Borsboom, and Mackenbach (2000) examine the association between prosperity and traffic accident mortality in industrialized countries in a long-term perspective (1962-1990) and find that in the long-term the relation between prosperity and traffic accident mortality appears to be non-linear. Kopits and Cropper (2005) use linear and log-linear forms to model region specific trends of traffic fatality risk and per income growth using panel data from 1963 to 1999 for 88 countries. Abbas (2004) compares the road safety of Egypt with that of other Arab nations and G-7 countries, and develops predictive models for road safety.

Other analyses entail a specific road safety related problem, applying international macroscopic comparison techniques to a subset of road network users, such as novice or young drivers. Twisk and Stacey (2007) presented a general study of identified trends in young drivers risk and associated countermeasures in certain European countries. The relationship between general safety levels and young driver risks is

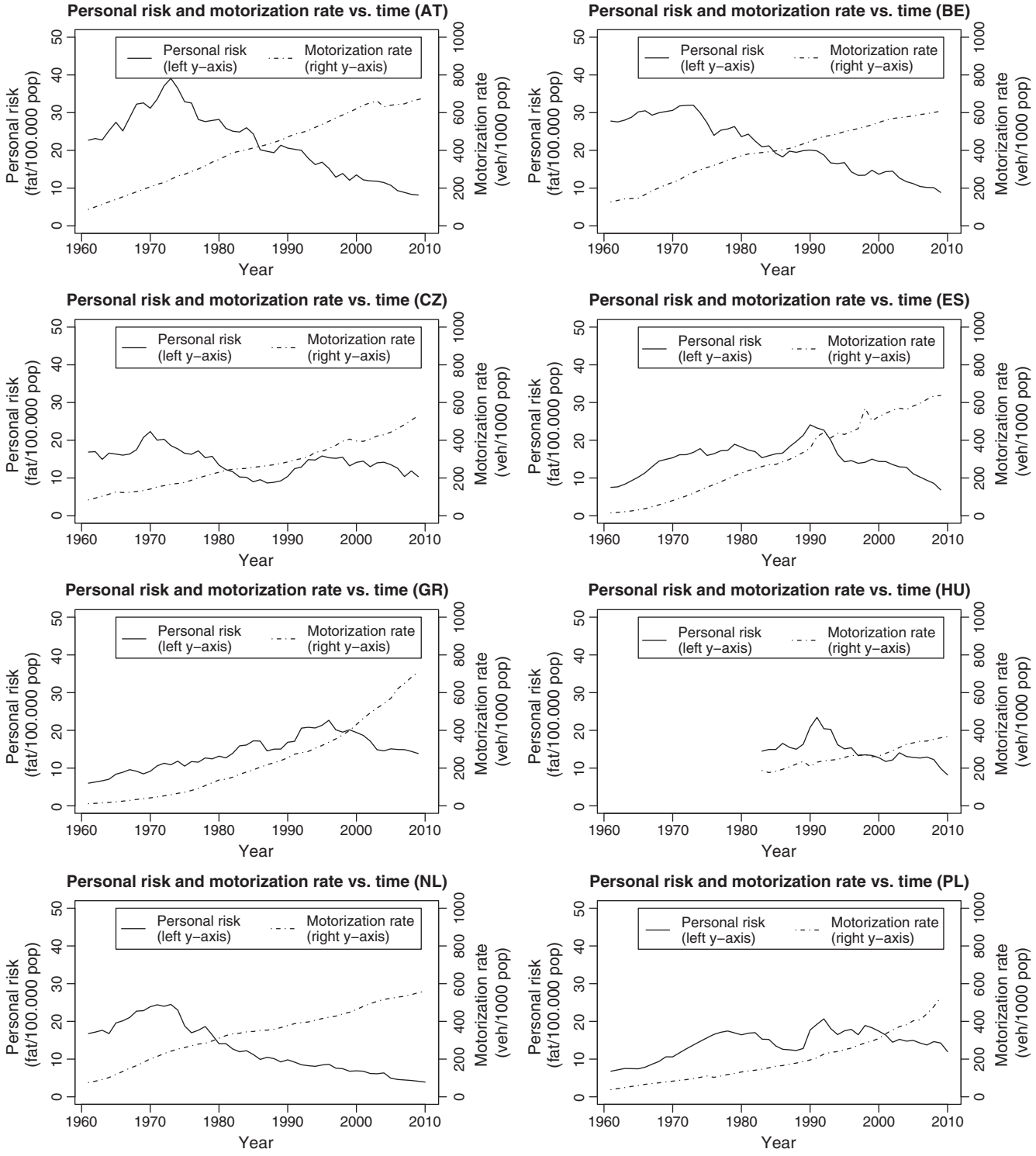

Fig. 1. Plot of Personal risk over Motorization rate for selected EU countries (1960-2008/2009). From top left to bottom right: Austria, ,Belgium, Czech Republic, Spain, Greece, Hungary, the Netherlands and Poland).