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The likelihood of achieving quantified road safety targets: A binary logistic regression model for possible factors

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ABSTRACT

In past several decades, many countries have set quantified road safety targets to motivate transport authorities to develop systematic road safety strategies and measures and facilitate the achievement of continuous road safety improvement. Studies have been conducted to evaluate the association between the setting of quantified road safety targets and road fatality reduction, in both the short and long run, by comparing road fatalities before and after the implementation of a quantified road safety target. However, not much work has been done to evaluate whether the quantified road safety targets are actually achieved. In this study, we used a binary logistic regression model to examine the factors – including vehicle ownership, fatality rate, and national income, in addition to level of ambition and duration of target – that contribute to a target's success. We analyzed 55 quantified road safety targets set by 29 countries from 1981 to 2009, and the results indicate that targets that are in progress and with lower level of ambitions had a higher likelihood of eventually being achieved. Moreover, possible interaction effects on the association between level of ambition and the likelihood of success are also revealed.

1. Introduction

There has been a global reduction in road fatalities over the past three decades due to the adoption of various road safety programs and policies, especially in European Union (EU) Member States. Organizations such as the World Health Organization (WHO), the Organization for Economic Co-operation and Development (OECD), the European Transport Safety Council (ETSC), and International Transport Research Documentation (ITRD) are committed in establishing a systematic road safety management systems, setting quantified road safety targets, and motivating timely action plans to achieve continuous and considerable road fatality reductions (Elvik, 1993; OECD Scientific Expert Group, 1994, 2008; Wegman et al., 2008; European Transport Safety Council (ETSC), 2011).

Quantitative road safety targets for fatality reductions must be ambitious and yet achievable (European Transport Safety Council (ETSC), 2003). Studies have been conducted to estimate the degree to which a target has been realized by comparing the road fatalities before and after the deployment of the respective target using a treatment-comparison group approach (Elvik, 2001; Allsop et al., 2011). Compared with countries lacking targets, target deployment was found to correlate with significant road fatality reductions, both in the short and long run. More importantly, a favorable effect on the time-series trend of road fatalities was observed during the period the target was in effect (Wong et al., 2006; Wong and Sze, 2010).

Although the sustainable favorable effects on fatality reduction have been realized, it is essential to determine appropriate targets that can lead to successful safety improvements. Based on information about current and future road safety performance forecasts, implementation plans for different road safety policies and measures, and the predicted effects of individual road safety actions, it is possible to estimate the likelihood of achieving a road safety target. Therefore, realistic quantified road safety targets can be set by referring to the existence of legislative and engineering interventions and the implementation of such interventions, controlling for the time-series trend of road safety level (Kweon, 2010). In addition, inputs from safety experts on the likelihood of and reasons for target achievement are essential. Attempts have been made to set appropriate targets for individual EU Member States to achieve optimal road fatality reduction throughout the EU as a whole. For instance, appropriate quantified road safety targets

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were set based on historical road safety trends, predicted future potentials, the capability to implement road safety measures, the achievement of preceding targets, interest and focus, and the economic status of individual EU Member States (Wittenberg et al., 2013).

Stimulating effective road safety management systems with policy documents, action plans, and guidelines is essential to the success of road safety targets. Attempts have been made to categorize individual EU Member States based on various road safety performance indicators with respect to different exposure measures, including population, vehicle fleet, and vehicle kilometric. In particular, the effectiveness of the road safety management systems of individual Member States has been benchmarked against better performing Member States in terms of policy making, action planning, and setting road safety targets in respective categories (Shen et al., 2012). Various safety performance indicators related to road infrastructure, vehicle technology, and road user behavior can be generated and a composite safety performance indicator adopted as a management tool for setting appropriate road safety targets in the development of appropriate road safety strategies and countermeasures (Tingvall et al., 2010). A better understanding of optimal target setting and its relationship with existing road safety management systems as it pertains to the predicted effect of time- series trends in road safety is expected to noticeably enhance road fatality reduction and sustained safety performance.

Nevertheless, it is desirable to evaluate the level of achievement in countries setting quantified road safety targets by comparing the targeted and actual reductions in road fatalities. In this study, we evaluate the performance of 55 quantified road safety targets set by 29 countries using a cluster analysis to categorize the targets into groups with similar characteristics, such as fatality rate, vehicle ownership, national income, time of target setting, and level of ambition. A binary logit regression is applied to assess the success of the targets and the relationships between the likelihood of achievement and possible factors including fatality rate, vehicle ownership, level of ambition, target duration, and whether a target is completed or not. Comparing the targeted and revealed reductions in fatalities in countries with quantified road safety targets should provide insights that could be valuable to decision makers in setting appropriate targets.

The remainder of the paper is structured as follows. The data on quantified road safety targets and road fatalities used in this study are described in Section 2. Section 3 details the application of the cluster analysis in categorizing the identified quantified road safety targets. The results of the binary logistic regression of the likelihood of target achievement and possible influencing factors are presented in Section 4. Section 5 discusses the implications of our results and provides recommendations for planning road safety strategies and programs. We conclude the study with suggestions for future research in Section 6.

2. Data

The focus of this study is the achievement of road fatality reductions in target years through quantified road safety targets. The details of established quantified road safety targets are the fundamentals of this study. Information on 55 targets in 29 selected countries, including the base year, target period, and target road fatality reduction, for the period 1981–2009 are obtained from key publications issued by the Institute of Transport Economics in Norway and the OECD Scientific Expert Group (Elvik, 2001; OECD Scientific Expert Group, 2012, 2014), in addition to the national study reports and technical papers listed in the References. The details of the quantified road safety targets under investigation are presented in Table 1. The fatality data for the 1981–2012 period are extracted from the International Road Federation (IRF) World Road Statistics (International Road Federation (IRF), 2013).

As shown in Table 1, of the 55 targets, 7 were established in the 1980s, 21 were established in the 1990s, and almost one half (27, 49%) were established in the 2000s. Summary statistics of the 55 targets under investigation are presented in Table 2.

Table 1
Details of targets under investigation.

Country	Base year	Target year	Target[a]	Country	Base year	Target year	Target[a]
Argentina	2009	2014	50%	Israel	2005	2010	24%
Australia	1992	2001	2%[b]	Italy	2001	2010	50%
Australia	1997	2005	10%	Japan	2000	2010	14%[b]
Australia	2001	2010	40%	Korea	2007	2012	50%
Austria	1998–2000	2004	25%	Lithuania	2004	2010	50%[b]
Austria	1998–2000	2010	50%	Malaysia	2005	2010	27%
Belgium	2001	2006	28%	Netherlands	1985	2000	25%
Belgium	2007	2010	30%	Netherlands	1998	2010	30%[b]
Canada	1996–2001	2008–2010	30%	Netherlands	2008	2020	33%[b]
Czech Republic	2002	2010	50%[b]	New Zealand	1990	1994	11%[b]
Denmark	1986–1988	2000	40%	New Zealand	1990	2001	42%
Denmark	1998	2012	40%[b]	New Zealand	1999	2010	42%
Denmark	2006	2012	35%[b]	Norway	1984–1986	1993	0%[b]
Finland	1986	1994	40%	Norway	2004	2015	30%[b]
Finland	1988	2000	50%	Norway	2009	2020	33%[b]
Finland	2000	2010	37%	Poland	1991	2001	24%[b]
France	1997	2002	50%	Poland	1997–1999	2010	43%[b]
France	2007	2012	35%	Poland	2003	2013	50%
Great Britain	1981–1985	2000	33%[b]	Portugal	1998–2000	2009	50%[b]
Great Britain	1994–1998	2010	40%[b]	Portugal	2009	2011	1%
Great Britain	2005–2009	2020	37%[b]	Spain	1992	1999	30%
Greece	2000	2005	20%	Spain	2003	2008	40%[b]
Greece	2000	2015	40%[b]	Sweden	1989	2000	56%
Hungary	2001	2010	30%[b]	Sweden	1996	2007	50%
Iceland	1991–1996	2000	11%	Sweden	2007	2020	50%[b]
Iceland	1999–2003	2016	50%[b]	Switzerland	2000	2010	50%
Ireland	1997	2002	20%[b]	United States	1996	2008	20%
Ireland	2007	2012	20%[b]				

[a] Percentage reduction in road fatalities in the target year compared to the base year.
[b] Target that is regarded as being achieved.