Estimating the Value of Life, Injury, and Travel Time Saved Using a Stated Preference Framework

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A B S T R A C T

The incidence of fatality over the period 2010–2014 from automobile accidents in North Cyprus is 2.75 times greater than the average for the EU. With the prospect of North Cyprus entering the EU, many investments will need to be undertaken to improve road safety in order to reach EU benchmarks. The objective of this study is to provide local estimates of the value of a statistical life and injury along with the value of time savings. These are among the parameter values needed for the evaluation of the change in the expected incidence of automotive accidents and time savings brought about by such projects.

In this study we conducted a stated choice experiment to identify the preferences and tradeoffs of automobile drivers in North Cyprus for improved travel times, travel costs, and safety. The choice of route was examined using mixed logit models to obtain the marginal utilities associated with each attribute of the routes that consumers choose. These estimates were used to assess the individuals' willingness to pay (WTP) to avoid fatalities and injuries and to save travel time. We then used the results to obtain community-wide estimates of the value of a statistical life (VSL) saved, the value of injury (VI) prevented, and the value per hour of travel time saved. The estimates for the VSL range from €315,293 to €1,117,856 and the estimates of VI from € 5,603 to € 28,186. These values are consistent, after adjusting for differences in incomes, with the median results of similar studies done for EU countries.

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1. Introduction

In 2014 there were 1.3 million fatalities on the world's roads. Approximately 92% of global traffic fatalities occurred in low- and middle-income countries. These countries contain 53% of the registered vehicles in the world (World Health Organization, 2013). In addition to the direct pain and suffering incurred, traffic accidents can push victims' families into poverty through the loss of a key caregiver, loss of productivity, loss of income, cost of medical care, damage to property, rehabilitation, and burial costs. The large number of victims created by traffic accidents and the seriousness of the consequences represent a major economic and public health problem (Gopalakrishnan, 2012). This study investigates the attitudes of the automotive drivers and passengers in the northern part of Cyprus to the risks of fatality and injury from road accidents. Esti-

mates are made of the value of a statistical life (VSL) and the value of injury (VI) obtained through a choice experiment survey carried out on the population who live in this region.

Through the quantification of the benefits of improved road safety and the measurement of the willingness to pay (WTP) to reduce casualty risk, one can obtain a measure of the VSL (Andersson, 2007; Elvik et al., 2009). This parameter has traditionally been measured using contingent valuation, standard gamble, or chain method techniques, which basically express the risk of accidents as the probability of an accident occurring (Beattie et al., 1998; Carthy et al., 1998; Jones-Lee, 1994; Jones-Lee et al., 1993; Viscusi et al., 1991). These methods involve a monetary valuation of road safety that implies a tradeoff between money and risk, and have been criticized by specialists in human behavior (Fischhoff, 1991, 1997) and some economists (Diamond and Hausman, 1994; Hausman, 1993). They have pointed out that a common defect of contingent valuation studies arises from the embedded effect where people have a positive feeling or WTP about supporting an activity in general. Often the valuations people make of public goods are not consistent when they are asked to express their WTP for a series of interventions separately as compared to their valua-

tion of the interventions when bundled together. Furthermore, in some cases the absence of direct market parallels affects the ability of the researcher to judge the quality of contingent valuation responses. This problem is at least partially solved in situations when one is able to observe direct expenditures made by individuals on averting or coping activities in order to alleviate the situation that is the focus of the contingent valuation. In the case of road safety, the actual decision that people make involves choosing between bundles of attributes that describe alternative routes. Hence, it is necessary to estimate the values of each of the attributes that can be bundled into different combinations to describe the services received from the various routes.

A number of recent studies on the valuation of road safety have used a different approach based on stated choice (SC) or conjoint analysis techniques (Hensher et al., 2009; Iragüen and de Dios Ortúzar, 2004; Rizzi and de D. Ortúzar, 2003, 2006; Svensson and Johansson, 2010). An SC analysis is an experiment in which individuals are asked to choose between different alternative combinations and levels of alternative road attributes. Therefore, SC implicitly reveals the actual behavior of people and is a more appropriate technique for the valuation of intangibles (Louviere et al., 2000; McFadden, 1998).

In this study the SC experiment focuses on the preferences of Turkish-Cypriot drivers for travel times, travel costs, and improvements in safety for routes based on a bundle of attributes that is described in each choice set. In this way, an estimate of the ex ante WTP of drivers to reduce their risk, and hence the value of risk reduction (VRR), can be made. This parameter value is a key piece of information in the evaluation of road safety and time-saving measures (Hensher, 1994; Hensher et al., 2005).

1.1. Road safety in North Cyprus

Cyprus is the third largest island in the Mediterranean. Turkish Cypriots live in the northern part of the island, which comprises about a third of the total land area of the island. According to the 2012 Census, North Cyprus had a population of 286,257. The average age of the population of North Cyprus in 2012 was 33, while the life expectancy at birth for males is 79.6 years and for females it is 83.1 years. The annual per capita gross national income (GNI) in 2014 was €10,989.[1] In 2014 the official minimum wage was TL1, 675 (€572) per month (€6864 per year). The gross domestic product (GDP) was derived heavily from tourism (21%) and higher education services (11.5%), with a further 12% coming from transportation and communications.

The rate of unemployment in 2014 was 8.3% (Economic and Social Indicators, 2014). Because North Cyprus is a small island country with eight universities serving both the local and the international markets, much of the unemployment consists of recent graduates who are seeking local professional employment and who often end up moving to Turkey or to other EU countries to find such jobs. At the same time more than 25,000 guest workers from Turkey were employed in virtually every occupation in North Cyprus (Economic and Social Indicators, 2014). Hence, unemployment is largely a function of young people not finding the quality of jobs they are looking for, given their option of working abroad, rather than the absence of available jobs. Owing to a strong extended family tradition and a generous social security system, the incidence of poverty among the Turkish Cypriots is quite low.

In North Cyprus, the available modes of transport are road, sea, and air, and there are no railways in the country. All inter-urban transport is by road. In 2012 there were 260,084 registered motor vehicles, while the number of driving licenses issued was 419,030 (Census, 2012). Of the 7,000 km of roads in North Cyprus, about two-thirds are paved. The average distance between the five districts of Northern Cyprus is 47.68 km.

Over the period 2010–2014, North Cyprus experienced, on average, 40 road accident fatalities per year, or 140 fatalities per million population. The incidence of fatalities from automobile accidents is 2.75 times greater than the average for Western Europe over the same period. The incidence of various non-fatal injuries is about 30 times greater than the number of fatalities, averaging 1,067 injuries per year, or 3,727 injuries per million population (Census, 2012; European Commission Road Safety Statistics, 2014; Road Traffic Accident Prevention Association, 2014). By comparison, the number of industrial accidental deaths in North Cyprus over the same period averaged five per year, with an average of 247 non-fatal accidents per year (Turkish Republic of Northern Cyprus, Ministry of Labor and Social Security, 2015). As a percentage of the labor force the annual rate of non-fatal accidents is 0.2% in North Cyprus, while for the average for the labor force in the EU it is 1.6% (Eurostat, 2015). While safety in the work place in North Cyprus appears to be relatively better than in the EU, the level of safety in automobile transportation is much worse.

The main cause of traffic accidents in North Cyprus is the behavior of drivers (80%), including speeding, alcohol, lack of attention, inadequate sleep, reckless driving, and non-compliance with the traffic signs. The second most important cause is the road environment (20%) or the road layout, including road bends, narrow carriageways, mud deposits, animals or other objects in the carriageway, poor and defective road surfaces, inadequate road signs or markings, and lack of traffic signals. On the other hand, driving licenses are issued without examination to foreigners who already have a driving license from elsewhere. This is particularly dangerous for a small country with an international university student population of over 50,000, and many long-term tourists from countries with lax driving regulations. There is not even an official handbook for learner drivers to study the rules for their written examination. Young children and citizens aged 21–44 years are found to be the most vulnerable road users (Road Traffic Accident Prevention Association, 2014).

Reducing this major social problem, which has economic consequences, will require the selection and implementation of many new investments in the areas of road transport, road safety, and driver education. While the road network is fairly extensive, it is generally of low quality. Highways between cities need to be widened with adequate road breakdown lanes; overpasses need to be built at important highway junctions; barriers are needed to separate traffic moving in opposite directions on high-volume expressways with lane dividers installed or improved on busy urban streets; and modern roundabouts need to be built to replace many existing small roundabouts or busy four-way stop junctions. The important task will be to select those projects, from the many possible ones proposed, that could be justified on the basis of cost–benefit or cost–effectiveness analysis. To conduct such appraisals, a number of key parameter values are required. Three such parameters are the value of time saved by individuals in travel from road improvements, the value per life saved and the value of injury prevented through the reduction of traffic accidents as a result of improvements in road safety. The objective of this paper is to obtain credible estimates of these parameters for North Cyprus.

Although North Cyprus has experienced exceptionally high fatality and injury rates from car accidents, this is the first study to elicit the road safety preferences of car drivers. In this survey, car drivers were asked to choose among different alternative sce-

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[1] The exchange rate between the Turkish Lira (TL) and the euro is 2.93TL/euro for 2014. This value is obtained using the average exchange rate of €1 = TL2.93 for May 2014 and was taken from the Central Bank of the Republic of Turkey's website (Central Bank of the Republic of Turkey, 2016).