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Willingness-to-pay for road safety improvement

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ABSTRACT

Few studies have explored, to date, the issue of the monetary valuation of non-fatal injuries caused by road traffic accidents. The present paper seeks to raise interest in this question and to estimate, by contingent valuation, French households' willingness-to-pay (WTP) to improve their road safety level and reduce their risk of non-fatal injuries following a road accident. More precisely, a Tobit and a type-II Tobit model were estimated to identify factors for WTP. The results highlighted the significant positive influence of injury severity on WTP. Experience of road traffic accidents seemed to play an important role, positively influencing valuation of non-fatal injury.

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1. Introduction

Road safety lies at the heart of several critical issues. Road accidents have serious consequences, at both economic and public health levels. These include loss of productive capacity, income or human resources following a road accident. If we add to this the damage to property and costs of medical care and related rehabilitation, the burden resulting from road accidents quickly becomes considerable.

Globally, the cost of traffic accidents represents 1–3% of gross national product and road accidents will rank as the fifth leading cause of death by 2030 if no rapid significant progress in road safety occurs (WHO, 2009).

Aware of these issues, most European countries have achieved significant progress in this area over the years, especially within the European Union since the White Paper on European transport policy[1], and in France since 2002, when road safety was made a major national cause.

The decrease in the number of people injured and killed on the roads in recent decades partly reflects the effectiveness of the measures implemented. It is important to keep in mind that road safety measures represent a significant financial burden on government budgets as well as family budgets. This certainly explains the recent interest of policy decision-makers for assessment and prioritization tools for transport and infrastructure projects, monetarizing the benefits expected from road safety measures.

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[1] White Paper, presented by the European Committee on September 12th 2001: "*European transport policy for 2010: time to decide*". This White Paper was accompanied by a new road safety action plan for the period 2002–2010, aiming to halve the number of deaths on the road.

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Basically, economic assessment of road safety measures raises the issue of valuation methods. While estimating the damage avoided by the introduction of a road safety measure is relatively easy and explicit, valuation of the reduced risk for health and life that it generates is more delicate. An extensive literature has examined this issue and tried to estimate the value associated with a reduced risk of injury, whether mild or fatal, resulting from road accidents. Since the 1980s, significant progress has been made in monetary valuation.

The somewhat controversial human capital approach (Arthur, 1981; Jones-Lee and Loomes, 2003; Jeremic et al., 2012) has been gradually abandoned. This method had significant limitations because it estimated damage (death or injury) only according to economic impact: that is to say, mainly in terms of loss of production. The intrinsic value of the damage and suffering resulting from injury or loss of life was completely hidden. To avoid this pitfall, an approach focusing on individual preferences and perceptions was developed: the willingness-to-pay (WTP) method (Mishan, 1971; Weinstein et al., 1980). WTP is defined as the maximum amount of money a subject is willing to pay to reduce his or her risk of premature death or personal injury due to a risky activity (in the present case, road transport).

There are two distinct methods of estimating WTP: the revealed preference method, and the stated preference method. The first is based on observation of subjects' everyday behavior, whether consumption or investment, to infer the value placed on non-market goods. For example, study of individual behavior in the car market has helped to highlight the trade-off subjects make between wealth and physical risk (Atkinson and Halvorsen, 1990; Dreyfus and Viscusi, 1995; Andersson, 2005; Andersson and Svensson, 2008). The stated preference method, in turn, differs in its hypothetical character: it involves not observing actions in existing markets but rather intentions to purchase or invest, and consists of exposing agents to virtual scenarios in which the good assessed is subject to change.

The most common stated preference method in the literature is the contingent valuation (CV) technique. Respondents are asked the maximum amount of money they are willing to pay for a variant of the good of interest (Beattie et al., 1998; Carthy et al., 1998). It is thus possible to directly obtain the amount that subjects are willing to spend to improve their road safety level and determine, more broadly, the value they seem to attribute to a healthy life without injury.

Whatever valuation method is used, the valuation of the benefit deriving from road safety measures was long limited to valuation of the number of avoided deaths. Much of the literature focused on estimating WTP for a reduction in the risk of fatal accident and on the calculation of the value or price of the risk, collectively named "the value of a statistical life" (Rizzi and Ortuzar, 2003; Iraguen and Ortuzar, 2004; Hojman et al., 2005). Numerous Swedish studies were also interested in individual WTP for total elimination of the risk of fatal accidents or severe wounds (Hultkrantz et al., 2006; Andersson, 2007, 2008; Svensson and Johansson, 2010), based on the famous concept of "Vision zero", which aims at achieving a highway system without fatalities or serious injuries.

In contrast to the above studies, the present paper is interested in the valuation of more or less serious non-fatal injuries caused by traffic accidents. More specifically, it estimates road users' WTP for a reduced risk of being a victim of various types of non-fatal injury. To do so, contingent valuation was conducted on the adult population (aged 18 years and older) of a French administrative *Département*[2] (Rhône) during the year 2012.

Few studies have taken account of the severity of non-fatal injuries in estimating WTP for road safety improvement. Previous analyses of French data were limited to the specific population of young drivers (18–25 years) (Lassarre et al., 2005; Lahatte et al., 2006). Participants were asked their WTP to avoid diverse consequences of a road accident. Injury severity was also indirectly integrated in the study of Australian data by Hensher et al. (2009) by the method of discrete choices to reveal individual preferences (Louviere et al., 2000). Subjects were asked to choose between different routes for a particular trip. The attribute levels of each alternative (probability of death or non-fatal injury, and time and cost of travel) varied according to a statistical design. Responses allowed observation of the individual choices made between different attribute-level bundles and estimation of the subjects' WTP for a reduction in their risk of fatal and non-fatal injury.

The aim of our approach was threefold. Firstly, we tried to determine whether there is a relationship between individual WTP and injury severity, without focusing on a specific population as in previous French studies (Lassarre et al., 2005; Lahatte et al., 2006). Secondly, we tested whether WTP depends on the degree of risk reduction, after scale bias is taken into account. The literature has shown WTP to be invariant, regardless of the degree of improvement proposed (Beattie et al., 1998; Hammitt and Graham, 1999). This apparently surprising insensitivity, or "scale bias", is explained by the difficulty subjects have in evaluating and distinguishing small changes in risk (Carson et al., 2001). A recent Swedish study showed that this bias was greater in respondents with lower cognitive ability to understand and distinguish statements of low probabilities (Andersson and Svensson, 2008). Finally, we studied the socio-economic factors that may be involved in determining road users' WTP.

In what follows, the paper comprises Section 2, the materials and methods used to conduct the study; Section 3 provides an overview of results; and finally we discuss the results in Section 4, before formulating conclusions and perspectives.

2. Material and methods

2.1. Participants

The target population was the residents of the Rhône *Département,* divided into two categories: "cases" and "controls". Members of the "case" group were inhabitants of the Rhône, aged 18 years and older, who were victims of a road accident

[2] A *Département* in France is equivalent to a UK or US county.

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