



# Exploring the public's willingness to reduce air pollution and greenhouse gas emissions from private road transport in Catalonia

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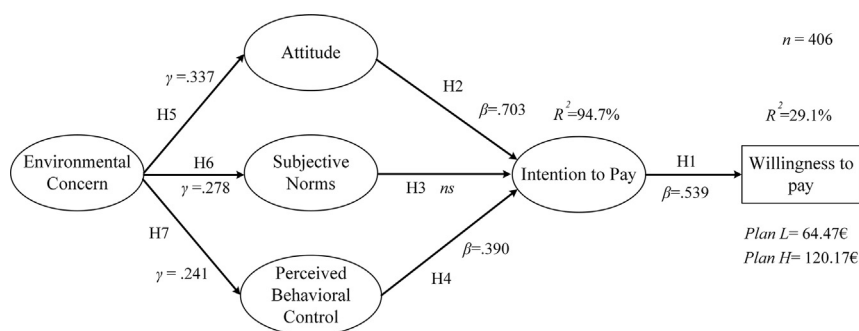
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## HIGHLIGHTS

- It is crucial for policy makers to explore public's willingness to pay to reduce air pollution and greenhouse gas emissions
- Theory of Planned Behavior can help to better understand the determinants of a pro-environmental behavior
- Environmental concern can be a good predictor of the main factors of the Theory of Planned Behavior
- Attitude, Subjective norms and Perceived control account for most of the intention to pay variance for reducing pollution
- More than 60% of the Catalan respondents are willing to increase the current transport taxes to reduce air pollution

## GRAPHICAL ABSTRACT



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## ABSTRACT

Internalizing environmental externalities is a market-driven approach to correcting people's private costs and benefits. One way of quantifying these externalities is estimating the willingness to pay (WTP) of people to reduce them. To better understand the determinants of this WTP, we use the Theory of Planned Behavior (TPB), which is a commonly used approach for predicting behavioral intentions. Our study focuses on air pollution and greenhouse gas (GHG) emissions from private road transport. We gathered survey data from 406 residents of Catalonia to explore the relationships among the psychological factors determining willingness to pay to quantify the mentioned externalities. We expanded the TPB by adding as antecedent Environmental Concern (EC) prior to the theory's three main factors (Attitude, Subjective Norms and Perceived Behavioral Control). Next, we used Structural Equation Modeling (SEM) to calculate an estimate of these externalities. The results of our study show that environmental concern is positively related to the three main factors of TPB. Our model accounts for most of the variation of WTP (R-squared is 94.7%). Our results also reveal that a majority of the respondents in Catalonia are willing to pay to reduce air pollution and GHG emissions from private road transport.

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## 1. Introduction

Among all transport externalities, especially those from road transport, greenhouse gases (GHG) and air pollution are the most challenging externalities to deal with (van Essen et al., 2011). Transport emissions are projected to double between 2010 and 2050 (OECD,

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2012). In 2010, all modes of transport produced 24.3% of total greenhouse gases emissions (GHG) of EU-27. Road transport accounts for 72.1% of these emissions (European Commission, 2013a). From the society point of view, these externalities are costs that are not taken into account by transport users. Having an estimate of these costs facilitates the planning and implementation of corrective policies (e.g. “polluter pays” policy) (Layton and Brown, 2000; van Essen et al., 2012). These externalities are estimated as representing 40% of total external costs of transport in EU-27, which was around €641/inhabitant—excluding congestion—in 2008 (van Essen et al., 2011). Many studies endeavor to quantify the environmental external costs of transport; some cover all negative externalities of transport (e.g. Kumar Sen et al., 2010) and others try to quantify specific external costs related to transport such as accident (Martin, 2005), noise (Arsenio et al., 2006), climate change (Lemp and Kockelman, 2008), air pollution and GHG emissions (Creutzig and He, 2009; Desaignes et al., 2011; Guo et al., 2010). These studies use various methods and conceptual frameworks to quantify externalities.

To design tools and implement plans to mitigate negative externalities, behavioral and technological changes are required. The cost of these changes should be estimated in order to assess the difficulty of implementing a corrective policy in terms of social acceptance of the policy, cost of technological change implied by the policy, and the like. For example, initially the public may approve a mitigation policy, but it is necessary to evaluate the degree of support for this policy as it will imply concrete changes that the public may not have been aware of (Bamberg et al., 2011; Layton and Brown, 2000). To address this, different surveying techniques can assess the public benefits of clean air and a stable climate. Nevertheless, the stated preferences methods approach is the only technique capable of estimating total economic value of these benefits in monetary terms (Bateman et al., 2004).

In the case of evaluating individual preferences and estimating the price of non-marketed goods such as air quality, one of the most popular, practical and recommended tools is the willingness-to-pay (WTP) approach (Bateman et al., 2002; Maibach et al., 2008; U.S. Environmental Protection Agency, 2011). Eliciting WTP from hypothetical situations can be done by any of several varieties of the Contingent Valuation (CV) methods (Bateman et al., 2004). Contingent Valuation, as a stated preference method, is a survey-based economic valuation approach that makes it possible to estimate the total economic value of a public good with no previous market value (Mitchell and Carson, 1989). It has been widely used by researchers to determine values of various environmental amenities and environmental damage, nature conservation and restoration, reduction of health risk and improvement of health indices, as well as public policy, cultural goods and other fields of study (Baranzini et al., 2010; Longo et al., 2012; Santagata and Signorello, 2000; Spash et al., 2009; Wang and Mullahy, 2006; Wang et al., 2015).

On the one hand, there is a growing interest in understanding public perceptions about air pollution and GHG emissions and how these perceptions influence the public's behavior regarding the environment (Dunlap et al., 2000). Some studies have focused on age, education, gender, income and marital status as socio-economic factors to analyze the essence of behavior toward the environment (Olofsson and Ohman, 2006; Torgler and García-Valiñas, 2007). Due to the limited power of previous studies to explain the variance of environmental behavior, researchers have recently shifted their attention to other psychosocial constructs such as values, beliefs and attitudes. These variables seem to have been useful factors for predicting pro-environmental behavior (Hoyos et al., 2009; Oskamp, 1995; Sauer and Fischer, 2010; Spash et al., 2009; Steg and de Groot, 2010; Vlek, 2000).

On the other hand, based on the findings in social psychology, attitude is the most commonly used predictor of economic value of a good (Ajzen and Peterson, 1988). WTP as an environmental attitude can be evaluated by using psychological concepts of behavioral theories (Ajzen, 1991; Ajzen and Madden, 1986; Gifford et al., 2011; Pouta and Rekola, 2001). In other words, analysis of psychological factors is needed

to understand the behavioral intentions of individuals, such as their intention to pay or stated WTP (e.g. Ajzen et al., 1996; Spash et al., 2009). There are plenty of studies that have analyzed intentions and attitudes by estimating people's WTP for using and conserving environmental goods (Hoyos et al., 2009; López-Mosquera et al., 2014) or reducing negative environmental impacts (Lera-lópez et al., 2013; Pouta and Rekola, 2001), as well as many studies on WTP estimation for air pollution and GHG emissions reduction. Some studies consider public and households' WTP for CO<sub>2</sub> emission reductions and mitigation (Adaman et al., 2011; Yang et al., 2014) or try to estimate households' WTP for improving air quality (Carlsson and Johansson-Stenman, 2000) and for reducing CO<sub>2</sub> emissions among different countries (Carlsson et al., 2012). Still other studies focus on air travelers' WTP for CO<sub>2</sub> mitigation (Brouwer et al., 2008) or their voluntary carbon offsets in an aviation context (MacKerron et al., 2009); and one discusses car buyers' consideration of a car's CO<sub>2</sub> emission performance in making car choices (Achtmeit, 2011).

In our study we use the Theory of Planned Behavior (TPB), one of the most commonly used approaches in the area of predicting behavioral intentions to estimate the value of non-marketed goods (e.g. Armitage and Conner, 2001; Bamberg et al., 2003; Bamberg and Schmidt, 2001; Fielding et al., 2008; Oreg and Katz-Gerro, 2006).

This paper aims to contribute to existing knowledge in the environmental economics literature by investigating how people feel and think about pollution reduction and how these factors can explain their intentions to engage in pro-environmental behavior. For this purpose, by using an extended model of TPB integrating environmental concern, we attempt to distinguish more clearly the psychosocial factors that play a role in determining individuals' WTP to reduce environmental externalities from private road transport.

In our study, we try to value air pollution and GHG emissions related to private car use according to the assessment of people in Catalonia (Spain). This study, in comparison with previous studies, has two elements which differentiate it from them. The first one refers to the model which is used. We extended the TPB model by adding environmental concern prior to the factors of the original model. The second one is that we use this extended model to examine the intention to pay to reduce air pollution and GHG emissions in case of private road transport. Extended versions of TPB have been used in the literature to explain different types of pro-environmental intentions, such as willingness to pay for abatement of forest regeneration (Pouta and Rekola, 2001), willingness to reduce personal car use (Nordlund and Garvill, 2003), willingness to pay for improving biodiversity (Spash et al., 2009) or for conserving a suburban park (López-Mosquera and Sánchez, 2012). However, to our knowledge there have been no studies that use the proposed extended model of TPB to examine WTP to reduce air pollution and GHG emissions in case of private road transport.

The paper is organized as follows. In the following sub-sections we lay out our theoretical framework, research hypotheses and theoretical model. In Section 2, the study methodology is presented. The results of analytical model are examined in Section 3. Section 4 contains the discussion and Section 5 summarizes the main conclusions.

### 1.1. Theoretical framework and research hypotheses

The Theory of Planned Behavior (TPB) assumes that attitudes, subjective norms and perceived behavioral control help us to better understand environment-related behaviors, such as “the behavior of paying money for a good” (Ajzen, 1991; Ajzen et al., 1996; Kaiser et al., 2005). Attitude refers to individuals' positive or negative evaluation of performing a behavior. Subjective norms represent the social pressure from the members of a reference group to act out a given behavior. Perceived behavioral control concerns the perceived ease or difficulty of performing a behavior. The majority of the studies using TPB have revealed that the individual's intention to engage in the behavior under investigation should be enhanced by a positive attitude, stronger subjective norms and higher perceived behavioral control (Ajzen, 1991; Liebe

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