Evaluating the Impact of Speed Limit Reductions on Greek Motorways: A Cost-Benefit and Acceptance Analysis

Stella Roussou*[1], Michalis Nikolaou[1], Virginia Petraki[1], George Yannis[1]

1. National Technical University of Athens, Department of Transportation Planning and Engineering, 5 Heroon Polytechniou str., Athens, GR-15773, Greece

*Corresponding author: s_roussou@mail.ntua.gr

Abstract

In this study, a cost-benefit analysis of lowering Greek motorway speed limits to 110 km/h from the current 130 km/h was conducted. A stated preference survey with multiple speed limit scenarios, contrasting travel time, fuel expenditures, and crash probability rates, was implemented. Data were analyzed using binary and multinomial logistic regression models to assess factors influencing public acceptance. The analysis further implements a Cost-Benefit Analysis (CBA) to evaluate the intervention's long-term sustainability from 2023–2032. Economic appraisal addresses four main dimensions: (a) improved road safety from reduced crash probability and severity, (b) reductions in environmental impacts through decreased emissions (CO_2, NO_2, PM), (c) economic reduction in fuel consumption, and (d) effects of an increase in travel time. Results indicate that the reduction in speed limit is economically beneficial and viable, with an excellent Net Present Value (ENPV = €10.9 million) and high Economic Rate of Return (ERR = 55.8%).

Keywords: *Speed limit, Stated Preference, Logistic models, Motorway, Cost-Benefit Analysis, Greece.*

1. Introduction

Road transportation is essential to modern life, and the increasing volume of travel is a leading contributor to traffic crashes (Yannis et al., 2015). The types, causes, and frequency of crashes on different road categories have been impacted by changes in road usage patterns over the past few decades, particularly on highways with high traffic volumes (Gaffney et al., 2023). Speed is still a significant risk factor, even though motorways are thought to be the safest kind of road because of their geometric design (Georgiadou, 2014). In addition to increasing emissions and fuel consumption (Montella et al., 2013), excessive speed is responsible for 28% of fatal crashes in the United States and 40.8% in Italy (NHTSA, 2015; Automobile Club Sandorio, 2018).

International studies have shown that highway fatality rates are 70% to 90% lower than those of other road types (Hoye et al., 2009; ERSO, 2018). Despite a 48.9% reduction in motorway crashes since 2007 (ELSTAT, 2023) and a 35% reduction in fatalities between 2012 and 2022 (ITF, 2023), there is still much room for improvement in Greece. Motorways accounted for 13.46% of fatal crashes in 2022, up from 6.1% in 2021 as post-COVID traffic resumed (NRSO, 2023). Additionally, the 2022 "Baseline" study showed 76.9% adherence to motorway speed limits with a mean speed of 103.3 km/h and a V85 speed of 117.8 km/h (NRSO, 2022)

When the speed limit on Melbourne's interurban road network was raised from 100 km/h to 110 km/h in 1987, the number of injuries increased by 24.6% (ECMT, 2006). Minor injuries decreased by 19% when the speed limit was subsequently raised back to 100 km/h (Sliogeris, 1992). Similarly, Finch et al. (1994) in Switzerland showed that reducing the speed limit from 130 km/h to 120 km/h led to a 5 km/h decrease in average speed and a 12% reduction in fatal crashes. Based on these examples, many countries have lowered their speed limits to meet by EU climate goals and Vision Zero strategies. Sweden and Finland—leaders in road safety—enforce maximum motorway speeds of 120 km/h. According to IRTAD, Greece's national goal is to have zero motorway fatalities by 2030 (ITF, 2023), and the country ranks eleventh out of 24 EU states in terms of motorway fatality rates (NRSO, 2023).

Reducing speed has been linked to improved road safety, lower fuel consumption, and less environmental impact. Lowering speed limits reduces the number of crashes and their severity. International studies show that for every 1 km/h drop in average speed, crash rates drop by 2–3% (Finch et al., 1994). Nilsson's Power Model (2004) states that lowering speed limits from 130 km/h to 110 km/h results in a 31% yearly decrease in fatal collisions. The Greek National Strategic Plan for Road Safety aligns with the EU's objective of halving fatalities by 2030 (Yannis et al., 2023). Lowering motorway speed limits aligns with this strategic framework and provides a number of public benefits related to economic, health, and climate goals.

An essential tool for assessing transportation projects is cost-benefit analysis, or CBA. It entails calculating an intervention's direct and indirect effects, such as improvements in safety, the environment, fuel economy, and travel time. According to research, even low time losses from slower speeds can be outweighed by substantial safety and environmental benefits (Benthem, 2015).To evaluate social welfare and identify which course of action benefits society more, CBA compares two scenarios: one with and one without the proposed project. It is now an essential tool for making investment decisions and frequently takes into account social and environmental effects in addition to financial ones.

CBA is a vital tool in transportation planning for assessing how changing the speed limit will affect society. While reducing travel times may help the private sector, increasing speed limits also increases the likelihood of collisions, emissions, and fuel consumption, all of which have an impact on the financial status of the public in general. CBA can be used to address questions like figuring out the ideal speed limit or whether societal benefits outweigh disadvantages. Benthem (2015) investigated speed limit increases in several U.S. states. CBA can be used to answer issues like determining the ideal speed limit or whether societal benefits outweigh disadvantages. When compared to the significant external costs they impose, such as harm to the environment and human health, higher speed limits, however, usually only produce modest time savings.

Many studies support this trade-off. For example, in Iran, increasing the speed limit from 90 to 120 km/h reduced travel time by 6.41 seconds per kilometer (Hosseinloui et al., 2015), while lowering the speed limit from 105 to 89 km/h in the U.S. increased travel time by 4.7% annually (Tarko et al., 2019). The average social cost of lost travel time is calculated to be €0.229 per hour, monetizing time savings. On the other hand, a 16 km/h speed increase on highways resulted in a 9% increase in fatal crashes as well as higher emissions of nitrogen oxides (8–15%) and carbon monoxide (14–24%) (Benthem, 2015). Its role as a decision-support tool in road safety policymaking is further supported by studies (Elvik, 2003; Daniels et al., 2019), which indicate that implementing CBA-based prioritization in Sweden and Norway could prevent 50–60% of fatal crashes.

This study investigates whether lowering the speed limit on Greek motorways from 130 km/h to 110 km/h can improve environmental sustainability and safety while still being financially feasible. The analyses implemented are binary and multinomial logistic regression models to interpret the results of a stated preference survey. To evaluate the long-term impacts on fuel savings, emissions, travel time, and crash severity, a cost-benefit analysis (CBA) was also carried out. This paper presents empirical data that will inform future policy decisions. The study's primary goal is to determine whether lowering speed limits on Greek motorways is advantageous from an environmental and safety standpoint and is also financially justified. Practically, the findings can guide national transportation policy, assist speed management initiatives, and assist Greece in achieving its 2030 Vision Zero objective. Additionally, the methodology can serve as a model for similar research on related sustainability and safety issues in other nations.

2. Methodology

2.1 Data Collection

The laboratory of Road Safety of the National Technical University of Athens conducted a structured questionnaire survey titled “Acceptance Analysis of Speed Limit Reduction on Greek Highways”. The survey data formed the empirical basis for the subsequent statistical analysis and cost-benefit evaluation of reducing speed limits. The primary goal was to identify the determinants influencing user acceptance regarding speed limit changes.

The questionnaire, with a duration of 15 minutes, was answered by 240 participants across various age groups (Agourou et al., 2023). It was structured into four sections and utilized a 4-point Likert scale ranging from “None” to “A lot” along with multiple-choice questions:

- Section 1 has as a goal to explore respondents’ driving profile—experience, crash history, and traffic violation records.
- Section 2 assessed participants' perceptions of speed-related risk and their sensitivity to traffic safety.
- Section 3 directly asked participants whether they agreed with reducing the speed limit from 130 km/h to 120 km/h or 110 km/h. This section also includes 10 hypothetical travel scenarios (based on a standard Athens–Patras route). Each scenario offered three choices: reduce to 110 km/h, reduce to 120 km/h, or maintain 130 km/h. These were associated with trade-offs in travel time, fuel cost savings, and reduced crash risk.

The scenarios in Section 3 examined how individuals choose between private costs (e.g. longer travel time) and societal benefits (e.g. lower crash risk and emissions). The scenarios tested respondents' willingness to sacrifice personal interests for greater public benefits. The survey data had to reflect the socioeconomic composition of the population (e.g., income, occupation), and the sample size had to be adequate for a valid inference.

Understanding participants’ perceptions of the role of speed in road safety is essential for interpreting their attitudes toward proposed speed limit reductions. Speed not only influences the likelihood of a road traffic crash occurring but also significantly affects the severity of its consequences. In this context, survey respondents were asked to assess how important they believe speed is in the occurrence and severity of crashes, as well as their perceived personal risk of being involved in a highway crash. These responses provide key insight into the public’s awareness and sensitivity toward speed-related risks.

Figure 1: *Respondents' opinion of the speed's importance*

In addition, general support for speed limit reduction was evaluated through two critical questions, which were posed to respondents in order to examine their agreement on two different scenarios, the one of lowering the speed limit from 130 km/h to 120 km/h and the other one of reducing the speed limit to 110 km/h. These questions offer a broad overview of public acceptance and serve as a basis for more detailed analysis through the stated preference scenarios that follow. The results help gauge initial attitudes and readiness for change, offering a valuable context for interpreting the detailed findings and policy implications of this study.

(a) (b)

Figure 2: *Respondent's agreement on speed limit reduction at 110 km/h (a) and 120 km/h (b)*

2.2 Theoretical Background

2.2.1 Statistical Analysis

This chapter presents the theoretical and methodological foundation of the study, focusing on the statistical tools and modeling techniques employed to analyze the impacts of reducing speed limits on Greek highways. It begins by clarifying essential statistical concepts such as variable types (quantitative vs. qualitative), reliability indicators like confidence levels and significance levels, and measures like the correlation coefficient, which informs multicollinearity concerns during regression modeling.

The chapter then discusses the Stated Preference (SP) method, which was chosen due to its flexibility in simulating hypothetical scenarios not yet present in real conditions. The SP method allows researchers to gather detailed information on user preferences under various speed limit scenarios by presenting respondents with trade-offs between travel time, fuel cost, and safety. Following this, the statistical modeling techniques are introduced. Unlike linear regression, logistic regression is appropriate when the dependent variable is discrete. The method enables the prediction of event probabilities (e.g., support for a policy) based on independent variables through the transformation of a utility function into a probability function.

Binary logistic regression is applied to assess respondents' support for reducing highway speed limits from 130 km/h to either 110 or 120 km/h. As for the multinomial logistic regression, it is used to evaluate preferences across three choices: reduction to 110 km/h, reduction to 120 km/h, or no change. The logistic function used to model this relationship is defined as:

$$Pi = \frac{e\ Ui}{1+e\ Ui} \qquad \textbf{(1)}$$

Where: $Ui = a0 + a1x1 + a2x2 + \cdots anxn$, and **(2)**

- U_i, utility function of I,
- $X_1 \ldots X_n$, variables of the case study,
- α_0, the constant term, which reflects the influence of factors that affect the choice but are not included as variables in the mathematical model,

- α_1.. αn, variables coefficients.

2.2.2 Cost-Benefit Analysis

The socioeconomic analysis for reducing the speed limit on Greek motorways was carried out with the European Commission's guidelines for Cost-Benefit Analysis (CBA) of investment projects (Sartori et al., 2014). Specifically, the analysis focused on the Corinth–Patras motorway section, which spans approximately 120 kilometers and is managed by Olympia Odos. The data used in this research for this section were derived from Olympia Odos' sustainability reports for the years 2018 to 2023.

Table 1: *Investment and operational costs of CBA*

Costs (-)	Benefits (+)
C1. Initial Investment Cost	**B1. Traffic related Benefits**
C1.1 Procurement and installation of camera systems	B1.1 Travel Time savings
C1.2 Upgrade of horizontal and vertical signage	B2. Fuel Consumption Reduction
C1.3 Cost of Traffic Control Center camera system	
C1.4 Procurement and installation of Variable Message Signs (VMS)	
C1.5 Study and design cost	
C2. Operational Costs	**B2. Externalities**
C2.1 Operation and maintenance of the Traffic Control Center	B2.1 Road Crashes
C2.1 Operation and maintenance of the Traffic Control Center	B2.2 Environmental Pollutants
C2.3 Operation and maintenance of mechanical equipment	B2.2.1 - CO2 Emissions
C2.4 Employment of additional personnel	B2.2.2 – NOX Emissions
C2.5 Biennial evaluation of the measure’s effectiveness	B2.2.3 – PM Emissions

Table 1 presents both the investment costs and the operational costs associated with the proposed speed reduction measure, as well as the corresponding benefits. The costs were categorized into initial investment costs (e.g., procurement and installation of IP CCTV cameras, signage upgrades, study expenses) and operational costs (e.g., traffic control center operations, maintenance of equipment and signage, public awareness campaigns). On the benefits side, gains were divided between user advantages—such as reduced travel time and fuel consumption—and externalities, including fewer road crashes and lower environmental pollution (CO_2 , NO_x, PM).

Following this cost and benefit categorization, a full CBA was conducted for the scenario of reducing the speed limit to 110 km/h. To assess the economic performance of the proposed measure, the following key indicators were calculated:

- Economic Net Present Value (ENPV): This is the difference between the total discounted benefits and costs over time. A project is considered economically viable when the ENPV is positive (ENPV > 0),
- Economic Rate of Return (ERR): This represents the discount rate at which the ENPV becomes zero. The ERR must exceed the Social Discount Rate (SDR), which in the case of Greece is typically estimated at 3% (European Commission, 2021),
- Benefit-Cost Ratio (BCR): This expresses the ratio of total discounted benefits to total discounted costs. A BCR greater than 1 indicates a profitable investment.

3. Results

To begin, the analysis implemented was one multinomial logistic regression based the data extracted from Section 3, the hypothetical scenarios section of the questionnaire, and two binomial logistic regressions in order to examine the public acceptance for reducing speed limits on Greek motorways from 130 km/h to 120 km/h, and from 130 km/h to 110 km/h.

3.1. Logistic Regression Models

3.1.1 Multinomial Logistic Regression Models

The optimal multinomial model was selected considering the pseudo R-squared value and a 5% significance level. To categorize the respondents' choices, the selected model includes the variables Time_norm and Crash_norm, with the results presented in Table 2. The coefficients and p-values demonstrate the statistical significance of these variables within the model.

Table 2: *Multinomial Logistic Regression Results*

MNLogit Regression Results						
Dep. Variable:			No. Observations:			2400
Model:	MNLogit		Df Residuals:			2394
Method:	MLE		Df Model:			4
			Pseudo R squ:			**0.3895**
			Log-Likelihood:			-1531
			LL-Null:			-2507
			LLR p-value:			0
Choice = 1	**Coef.**	**Std.Err.**	**z**	**P>|z|**	**[0.025**	**0.975]**
const	0.8922	0.252	3.535	0	0.398	1.387
Time_norm	2.9952	0.303	9.875	0	2.402	3.588
Crash_norm	-5.2611	0.334	-15.736	0	-5.916	-4.606
Choice = 2	**Coef.**	**Std.Err.**	**z**	**P>|z|**	**[0.025**	**0.975]**
const	-0.430	0.265	-1.619	0.105	-0.950	0.091
Time_norm	0.329	0.272	1.210	0.226	-0.204	0.863
Crash_norm	1.603	0.272	5.893	0.000	1.070	2.136

The creation of the multinomial logit model ("logit_model") yields two utility functions. The first utility function corresponds to the choice of reducing the speed limit from 130 km/h to 120 km/h, while the second corresponds to a reduction from 130 km/h to 110 km/h. Therefore, the utility functions are expressed as:

- $U_{Choice\ 1}$ = 0.8922 + 2.9952*Time - 5.2611*Crash **(3)**
- $U_{Choice\ 2}$ = -0.430 + 0.329*Time + 1.603*Crash **(4)**

In these equations, the first term represents a constant, the second reflects the impact of increased travel time, and the third term refers to the perceived reduction in the probability of injury-related road crashes. Based on these utility functions, the acceptance rates of the surveyed participants for each scenario were calculated and the results occurred to a 22% supporting the reduction to 110 km/h, a 49% supporting the reduction to 120 km/h and a 29% preferring no change (130 km/h).
The mathematical formulas for calculating these probabilities are:

$$Pchoice1 = \frac{e^{U(Choice\ 1)}}{1+e^{U(Choice\ 1)}+e^{U(Choice2)}} \quad \textbf{(5)} \qquad and \qquad Pchoice2 = \frac{e^{U(Choice\ 2)}}{1+e^{U(Choice\ 1)}+e^{U(Choice2)}} \quad \textbf{(6)}$$

Based on the final optimal multinomial logistic regression model from Table 2, the following conclusions are drawn:

- Time_norm: The factor of increased travel time contributes positively to the selection of the 110 km/h limit and 120 km/h limit,
- Crash_norm: The factor representing the reduction in Crash probability contributes negatively to the selection of the 110 km/h limit, contrasting the positive contribution to the selection of the 120 km/h limit.

This indicates that while respondents recognize the safety benefits of reducing the speed limit to 110 km/h, they also associate it with an excessive increase in travel time, which they are not willing to sacrifice. On the other hand, the 120 km/h limit is perceived as a reasonable compromise between safety and practicality. Therefore, we can conclude that Greek drivers are not inclined to compromise their daily travel time for a reduction to 110 km/h but are more accepting of a moderate decrease to 120 km/h.

3.1.2 Binomial Logistic Regression Model for speed limit reduction to 110 km/h

A binary logistic regression model was applied for the statistical analysis of the question "Do you agree with reducing the speed limit from 130 km/h to 110 km/h?". After examining all alternatives, the optimal scenario was selected based on the pseudo R^2 value and the 5% significance level. In each iteration, key model statistics were presented, including the regression summary, AIC (Akaike Information Criterion), and BIC (Bayesian Information Criterion).

Table 3: *Binomial logistic regression for speed limit reduction to 110 km/h results*

Reducing speed limit from 130 km/h to 110 km/h						
Logit Regression Results						
Dep. Variable:	C1		No. Observations:			2400
Model:	Logit		Residuals:			2361
Method:	MLE		Model:			38
			Pseudo R squ:			**0.4617**
			Log-Likelihood:			-895.15
			LL-Null:			-1662.8
			LLR p-value:			5.60E-298
	Coef.	**Std.Err.**	**z**	**P>|z|**	**[0.025**	**0.975]**
const	-1.153	0.521	-2.215	0.027	-2.173	-0.133
PROPERTY_ACCID_1	-2.316	0.280	-8.258	0.000	-2.865	-1.766
PROPERTY_ACCID_2	-2.208	0.277	-7.963	0.000	-2.751	-1.664
PROPERTY_ACCID_3	-1.580	0.277	-5.708	0.000	-2.122	-1.037
EXP_2	0.972	0.168	5.787	0.000	0.643	1.301
EXP_3	-1.275	0.241	-5.283	0.000	-1.748	-0.802
STAT_INJURIES_1	-2.395	0.227	-10.549	0.000	-2.840	-1.950
STAT_INJURIES_2	-0.305	0.152	-2.010	0.044	-0.603	-0.008
INJURY_ACCID_2	3.128	0.353	8.851	0.000	2.436	3.821
INJURY_ACCID_3	3.469	0.399	8.699	0.000	2.687	4.250
VIOLATIONS_3	-0.834	0.356	-2.341	0.019	-1.532	-0.136
WORRIED_1	1.294	0.278	4.650	0.000	0.748	1.839
WORRIED_2	1.128	0.218	5.180	0.000	0.701	1.555
WORRIED_3	1.088	0.203	5.349	0.000	0.689	1.486
SPEED_ROLE_2	2.173	0.380	5.720	0.000	1.428	2.917
SPEED_ROLE_3	1.337	0.155	8.630	0.000	1.033	1.641
MOTO_RISK_1	2.610	0.553	4.717	0.000	1.525	3.694
ACC_HIGHW_3	-1.740	0.197	-8.826	0.000	-2.127	-1.354
ACC_HIGHW_4	-2.140	0.201	-10.639	0.000	-2.534	-1.746
ACC_HIGHW_5	-1.645	0.259	-6.345	0.000	-2.153	-1.137
IF_ROAD_TYPE_1	0.884	0.476	1.858	0.063	-0.048	1.816
IF_ROAD_TYPE_2	-1.605	0.393	-4.087	0.000	-2.375	-0.835
IF_ROAD_TYPE_4	0.432	0.189	2.290	0.022	0.062	0.801
IF_TRAFFIC_1	-3.401	0.521	-6.532	0.000	-4.422	-2.381
IF_TRAFFIC_2	-1.844	0.286	-6.443	0.000	-2.405	-1.283
IF_TRAFFIC_3	0.438	0.179	2.441	0.015	0.086	0.789
IF_FREQ_1	2.476	0.376	6.583	0.000	1.739	3.214
IF_FREQ_2	2.852	0.262	10.897	0.000	2.339	3.365
IF_FREQ_3	-0.387	0.159	-2.436	0.015	-0.698	-0.076
IF_OTHERS_SPEED_2	-0.903	0.214	-4.214	0.000	-1.323	-0.483
IF_OTHERS_SPEED_4	-0.598	0.154	-3.881	0.000	-0.900	-0.296
GENDER_1	-1.165	0.149	-7.846	0.000	-1.456	-0.874

RLTNSHIP_1	-0.941	0.150	-6.273	0.000	-1.236	-0.647
INCOME_2	0.623	0.142	4.371	0.000	0.344	0.902
EDUCATION_3	2.667	0.304	8.781	0.000	2.072	3.262
EDUCATION_4	2.043	0.179	11.419	0.000	1.693	2.394
EDUCATION_5	0.523	0.199	2.622	0.009	0.132	0.913
EDUCATION_6	1.041	0.260	4.001	0.000	0.531	1.550
PROF_5	-2.268	0.389	-5.829	0.000	-3.030	-1.505

Numerous factors were found to be negatively correlated with support for reducing the highway speed limit from 130 km/h to 110 km/h. Respondents with more than ten years of driving experience (EXP_3), a history of crashes involving only property damage (PROPERTY_ACCID_1, _2, _3), or a tendency to downplay the severity of traffic crashes (STAT_INJURIES_1, _2) were less likely to support the measure. Additionally, participants who thought urban traffic conditions weren't important (IF_TRAFFIC_1, _2) or who estimated a high likelihood of being involved in a highway crash (ACC_HIGHW_3, _4, _5) showed lower levels of support. Demographic factors also contributed, as some occupational groups (PROF_5), women (GENDER_1), and unmarried people (RLTNSHIP_1) showed less positive attitudes.

However, support for lowering the speed limit was positively correlated with another set of variables. Participants who had experienced injury-related crashes (INJURY_ACCID_2, _3) and those who expressed greater concern about being involved in a traffic crash (WORRIED_1, _2, _3) were more likely to support the policy. Additionally, there was agreement among drivers who believed that riding a motorcycle at high speeds was dangerous (MOTO_RISK_1) and that speed significantly influences how serious crashes are (SPEED_ROLE_2, _3). More respondents supported the change if they had five to nine years of driving experience (EXP_2), were frequent users of the highway (IF_FREQ_1, _2), or believed that road type significantly affected their choice of speed (IF_ROAD_TYPE_4) and had an income range between 10.000 and 25.000 annually.

Additionally, a ROC curve was plotted to assess classification performance. The optimal model's ROC curve had an AUC value of 0.91, indicating excellent accuracy, as the curve approaches the top-left corner of the plot (high sensitivity and low false-positive rate). This means the model correctly identifies most positive responses while minimizing misclassifications.

3.1.3 Binomial Logistic Regression Model for speed limit reduction to 110 km/h.

The development process of the binary logistic regression model concerning question Q2 of the questionnaire, as well as the methodology followed, is identical to that applied for question Q1. Therefore, to avoid repetition, the primary results of the analysis are presented directly. The graphical representation of total responses to question Q2 — "Do you agree with reducing the speed limit from 130 km/h to 120 km/h?". The final selection of the optimal binary logistic regression model for question Q2 is presented in Table 4. It is noted that the AUC value on the ROC curve was 0.88, which is considered satisfactory, similar to the previous model.

Table 4: *Binomial logistic regression for speed limit reduction to 110 km/h results*

Reducing speed limit from 130 km/h to 120 km/h						
Logit Regression Results						
Dep. Variable:	C2		No. Observations:			2400
Model:	Logit		Residuals:			
Method:	MLE		Model:			
			Pseudo R squ:			**0.3711**
			Log-Likelihood:			-1034.4
			LL-Null:			-1644.8
			LLR p-value:			1.91E-231
	Coef.	**Std.Err.**	**z**	**P>|z|**	**[0.025**	**0.975]**
const	-4.398	0.654	-6.728	0.000	-5.680	-3.117

PROPERTY_ACCID_1	-0.615	0.166	-3.711	0.000	-0.939	-0.290
PROPERTY_ACCID_2	-1.133	0.168	-6.762	0.000	-1.462	-0.805
EXP_4	0.846	0.172	4.931	0.000	0.510	1.183
EXP_2	1.034	0.184	5.629	0.000	0.674	1.394
STAT_DEATHS_1	-2.646	0.344	-7.703	0.000	-3.320	-1.973
STAT_DEATHS_2	-1.482	0.159	-9.315	0.000	-1.794	-1.170
STAT_DEATHS_3	-0.361	0.154	-2.346	0.019	-0.662	-0.059
INJURY_ACCID_2	1.162	0.276	4.217	0.000	0.622	1.702
INJURY_ACCID_3	1.848	0.305	6.056	0.000	1.250	2.446
VIOLATIONS_1	2.416	0.295	8.195	0.000	1.838	2.994
WORRIED_1	0.419	0.219	1.913	0.056	-0.010	0.849
WORRIED_2	0.311	0.137	2.269	0.023	0.042	0.580
SPEED_ROLE_2	1.232	0.291	4.239	0.000	0.662	1.801
SPEED_ROLE_3	0.978	0.144	6.777	0.000	0.695	1.261
MOTO_RISK_1	2.362	0.450	5.244	0.000	1.479	3.245
MOTO_RISK_2	1.482	0.238	6.221	0.000	1.015	1.949
MOTO_RISK_3	0.492	0.133	3.697	0.000	0.231	0.753
ACC_HIGHW_3	0.545	0.160	3.401	0.001	0.231	0.860
ACC_HIGHW_2	2.227	0.179	12.425	0.000	1.875	2.578
ACC_HIGHW_5	2.344	0.229	10.251	0.000	1.896	2.793
IF_ROAD_TYPE_3	1.152	0.180	6.390	0.000	0.798	1.505
IF_ROAD_TYPE_1	1.080	0.394	2.743	0.006	0.308	1.851
IF_TRAFFIC_1	-1.093	0.390	-2.805	0.005	-1.856	-0.329
IF_TRAFFIC_2	-2.456	0.273	-8.991	0.000	-2.992	-1.921
IF_TRAFFIC_3	-0.643	0.163	-3.957	0.000	-0.962	-0.325
IF_FREQ_2	-1.258	0.393	-3.197	0.001	-2.029	-0.487
IF_FREQ_3	-1.894	0.364	-5.205	0.000	-2.608	-1.181
IF_FREQ_4	-1.658	0.359	-4.619	0.000	-2.361	-0.954
GENDER_1	-0.738	0.139	-5.320	0.000	-1.010	-0.466
RLTNSHIP_1	-1.012	0.250	-4.044	0.000	-1.503	-0.522
RLTNSHIP_2	-0.589	0.230	-2.559	0.010	-1.040	-0.138
INCOME_1	1.487	0.184	8.099	0.000	1.127	1.846
INCOME_2	0.702	0.169	4.151	0.000	0.370	1.033
EDUCATION_3	2.421	0.309	7.843	0.000	1.816	3.026
PROF_6	-0.530	0.277	-1.916	0.055	-1.073	0.012
PROF_3	1.218	0.233	5.225	0.000	0.761	1.675
PROF_2	1.019	0.277	3.679	0.000	0.476	1.562
CITY_1	1.139	0.138	8.273	0.000	0.869	1.409

The analysis of the logistic regression model for question Q2, which evaluated support for reducing the highway speed limit from 130 km/h to 120 km/h, revealed several important influencing factors. Negative correlations were observed between respondents with 9–14 years of driving experience (EXP_3) and those with no or minimal prior involvement in property-damage-only crashes (PROPERTY_ACCID_1, _2). Similarly, respondents were less likely to support the measure if they thought that Greece's annual road fatalities were between 1,000 and 10,000 (STAT_DEATHS_1, _2), indicating that the issue of road safety may have been understated. Additionally, drivers who estimated a moderate probability (12%–50%) of being involved in a highway crash (ACC_HIGHW_3 to _5) and those with three to six recent traffic violations (VIOLATIONS_3). In addition, individuals who considered road quality or traffic flow only slightly or not important when choosing driving speed (IF_ROAD_TYPE_2, IF_TRAFFIC_1 to _3) and those who perceived the speed of surrounding vehicles as important (IF_OTHERS_SPEED_2, _4) were less likely to favor the reduction. Respondents who were unemployed (PROF_5), female (GENDER_1), and unmarried (RLTNSHIP_1) were also less supportive of the policy.

On the other hand, drivers with five to nine years of experience (EXP_2), those who had been in two or more injury-related crashes (INJURY_ACCID_2, _3), and those who were moderately concerned about being involved in a crash (WORRIED_1, _2) all strongly supported the speed limit reduction.

Acknowledging the role of speed in crash severity (SPEED_ROLE_2, _3) also positively influenced support, as did considering road quality very important when choosing speed (IF_ROAD_TYPE_4). Interestingly, even respondents who did not view high-speed motorcycling as dangerous (MOTO_RISK_1) expressed support. More favorable attitudes were also recorded among those who considered highway driving frequency not very important (IF_FREQ_1, _2), people with annual incomes between €10,000 and €25,000 (INCOME_2), and respondents holding university or postgraduate degrees (EDUCATION_3 to _6). These findings suggest that awareness of road safety, prior crash experience, socioeconomic background, and specific driving attitudes all significantly influence public acceptance of speed limit reductions.

3.2. Cost-Benefit Analysis

This chapter offers a socioeconomic analysis of reducing the speed limit on the Korinthos–Patras section of the Olympia Odos motorway from 130 km/h to 110 km/h in compliance with EU cost-benefit analysis guidelines. Public support for the measure steadily increases, rising from 22% in 2023 to 100% in 2032. Vehicle kilometers and passenger hours were estimated using traffic data from Olympia Odos sustainability reports (Olympia Odos, 2023). Forecasts did not include 2020–2021 because of pandemic disruptions. For future estimation, an annual increase in traffic volumes of 6.73% was chosen based on the aforementioned reports.

The impact on safety is substantial. According to research, a speed limit of 110 km/h could lower fatalities by 32.5%, serious injuries by 29.3%, and minor injuries by 24.5%. Using Greek-specific social cost values per casualty type, total safety benefits over a decade are estimated at €25.3 million.

Initial investment costs are in total approximately €1.39 million, including the installation of cameras, radar, signage, and smart traffic monitoring systems. Operating costs, including maintenance, awareness campaigns, and performance evaluations, amount to €7.02 million over the ten-year period.

Table 5: *Benefits in Road Safety*

KPIs	**Slight Injuries/Year**				**Serious Injuries/Year**				**Fatalities/Year**				**Property Damage**			
Year	S0	S1	S1-S0	Benefit(€)	S0	S1	S1-S0	Benefit(€)	S0	S1	S1-S0	Benefit(€)	S0	S1	S1-S0	Benefit(€)
2023	28	26	-2	102.746	3	3	0	0	6	6	0	0	781	714	67	265.320
2024	28	25	-2	154.119	3	3	0	0	6	6	0	0	762	675	87	344.520
2025	28	24	-3	205.492	3	3	0	0	6	5	1	2.148.034	743	634	109	431.640
2026	28	23	-4	256.865	3	3	0	0	6	5	1	2.148.034	725	583	142	562.320
2027	28	22	-6	308.238	3	3	0	0	6	5	1	2.148.034	707	534	173	685.080
2028	28	22	-6	308.238	3	3	0	0	6	5	1	2.148.034	690	521	169	669.240
2029	28	22	-6	308.238	3	3	0	0	6	5	1	2.148.034	673	508	165	748.240
2030	28	22	-6	308.238	3	3	0	0	6	5	1	2.148.034	657	496	161	637.560
2031	28	22	-6	308.238	3	3	0	0	6	5	1	2.148.034	641	484	157	621.720
2032	28	22	-6	308.238	3	3	0	0	6	5	1	2.148.034	625	472	153	605.880
SUM	252	214	-44	2.568.650	27	27	0	0 €	54	42	-8	17.184.272	6.379	5.149	1.230	5.571.720
Total Benefits													**25.324.642 €**			

A 14.91% increase in travel time, however, partially offsets this benefit, resulting in a time-related socioeconomic cost of roughly €49.8 million over a ten-year period, based on a weighted value of €5.56/hour per passenger. Fuel consumption is projected to decrease by 16%, saving 37 million liters over ten years. With a net fuel price of €0.81/liter (excluding taxes), this results in a benefit of €30.0 million. Environmental gains include reduced emissions: 77,803 fewer tons of CO_2 (worth €17.3 million), 479 fewer tons of NO_x (€109.661), and 3 fewer tons of PM (€749).

Table 6: *Costs in Travel Time and Benefits of Fuel Consumption and Environmental Impact*

Year	Travel Time Costs	Fuel Consumtion Benefits	CO_2	NOx	$PM_{2,5}$
2023-2024	-1.947.146 €	2.123.644 €	450.112 €	1.534 €	21 €
2024-2025	-2.107.006 €	2.236.649 €	682.886 €	2.327 €	33 €
2025-2026	-2.870.818 €	2.205.264 €	971.906 €	3.311 €	45 €
2026-2027	-4.085.365 €	2.174.558 €	1.401.543 €	10.011 €	66 €
2027-2028	-5.450.387 €	2.144.447 €	1.902.543 €	13.334 €	86 €
2028-2029	-5.817.198 €	2.669.820 €	2.051.673 €	14.104 €	89 €
2029-2030	-6.208.696 €	3.550.186 €	2.183.441 €	14.825 €	91 €
2030-2031	-6.626.541 €	4.375.006 €	2.326.811 €	15.491 €	92 €
2031-2032	-7.072.507 €	4.311.602 €	2.569.691 €	16.768 €	97 €
2032-2033	-7.548.487 €	4.247.590 €	2.809.002 €	17.956 €	130 €
Total Sum	-49.761.150 €	30.068.766 €	17.349.959 €	109.661 €	749 €

The socioeconomic evaluation of the project is assessed positively. The Benefit-Cost Ratio (B/C) is calculated at 2.30, confirming the project's efficiency, as total benefits substantially exceed implementation and operational costs. Additionally, the Net Present Value (NPV) is positive, reaching €10.94 million, demonstrating the measure’s economic viability. However, its moderate value suggests that performance could be improved by mitigating travel time impacts or enhancing additional benefits. Despite increased travel time costs, the overall social and environmental benefits—particularly improved road safety and reduced emissions—ensure the project’s economic efficiency and long-term sustainability. Moreover, the project delivers significant external benefits, such as reduced CO_2 and PM emissions, which are critical for public acceptance and contribute to quality of life and environmental resilience.

Table 7: *Socio-economic analysis of the speed limit reduction to 110 km/h*

		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Benefits & Costs	**NPV 3.0%**	**Implementation**	**Operation**								
C1. Investment Costs (€)	**-1.388.709**	-1.430.370	0	0	0	0	0	0	0	0	0
C1.1 Traffic Detection Units	-349.515	-360.000	0	0	0	0	0	0	0	0	0
C1.2 Road Signs	-12.816	-13.200	0	0	0	0	0	0	0	0	0
C1.3 Study/Planning Costs	-333.175	-343.170	0	0	0	0	0	0	0	0	0
C1.4 Cameras & Software	-576.699	-594.000	0	0	0	0	0	0	0	0	0
C1.5 Bluetooth Readers	-116.505	-120.000	0	0	0	0	0	0	0	0	0
C2. Operating Costs (€)	**-7.018.003**	**-2.152.000**	**-652.000**	**-652.000**	**-652.000**	**-652.000**	**-652.000**	**-652.000**	**-652.000**	**-652.000**	**-652.000**
C2.1 Operation & Supervision Costs	-2.132.551	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
C2.2 Annual Maintenance of C1.4 & C1.5	-17.060	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000
C2.3 Contingencies	-1.456.311	-1.500.000	0	0	0	0	0	0	0	0	0
C2.4 Media Campaigns	-1.706.041	-200.000	-200.000	-200.000	-200.000	-200.000	-200.000	-200.000	-200.000	-200.000	-200.000
C2.5 Biennial Effectiveness Assessment of the Measure	-1.706.041	-200.000	-200.000	-200.000	-200.000	-200.000	-200.000	-200.000	-200.000	-200.000	-200.000

Total Investment and Operating Costs	**-8.406.712**	**-3.582.370**	**-652.000**	**-652.000**	**-652.000**	**-652.000**	**-652.000**	**-652.000**	**-652.000**	**-652.000**	**-652.000**

Economic Impacts – Benefits (€)											
User surplus_(-)	**16.013.121**	**+149.498**	**+129.644**	**665.554**	**1.910.807**	**3.305.940**	**3.117.378**	**2.658.510**	**2.251.535**	**2.760.905**	**3.300.897**
B1. Travel Time (-)	41.049.625	1.974.146	2.107.006	2.870.818	4.085.365	5.450.387	5.817.198	6.208.696	6.626.541	7.072.507	7.548.487
B2. Fuel Consumption	25.036.504	2.123.644	2.236.649	2.205.264	2.174.558	2.144.447	2.699.820	3.550.186	4.375.006	4.311.602	4.247.590
External Impact Benefits	**35.362.281**	**819.740**	**1.183.885**	**3.760.428**	**4.378.839**	**5.057.657**	**5.191.378**	**5.403.068**	**5.436.226**	**5.664.548**	**5.889.240**
B3. Road Safety	21.025.420	368.066	498.639	2.785.166	2.967.219	3.141.352	3.125.512	3.204.712	3.093.832	3.077.992	3.062.152
B4. Environment	14.336.862	451.674	685.246	975.262	1.411.620	1.916.305	2.065.866	2.198.356	2.342.394	2.586.556	2.827.088
B4.1 CO_2 Emissions	14.246.829	450.120	682.886	971.906	1.401.543	1.902.885	2.051.673	2.183.441	2.326.811	2.569.691	2.809.002
B4.2 NO_x Emissions	89.416	1.534	2.327	3.311	10.011	13.334	14.104	14.825	15.941	16.768	17.956
B4.3 PM Emissions	617	21	33	45	66	86	89	91	92	97	130
Total Benefits	**19.349.161**	**969.239**	**1.313.529**	**3.094.875**	**2.468.032**	**1.751.717**	**2.074.000**	**2.744.559**	**3.184.691**	**2.903.643**	**2.588.343**

ENPV/Net Benefits	**10.942.449**	**-2.613.131**	**661.529**	**2.442.875**	**1.816.032**	**1.099.717**	**1.422.000**	**2.092.559**	**2.532.691**	**2.251.643**	**1.936.343**
ERR>	**55.8%**										
B/C Ratio	**2.30**										

4. Conclusions

Using data from cost-benefit analysis (CBA), advanced statistical modeling, and stated preference surveys', this study examines the socioeconomic effects and public acceptance of lowering speed limits on Greek highways. The main objective was to assess whether lowering the speed limit from 130 km/h to 120 km/h or 110 km/h would benefit Greece's road safety system economically and socially.

The analysis of public acceptance from the questionnaire data demonstrates that Greek drivers have a complex viewpoint. Despite public opposition, a moderate reduction to 120 km/h is far more acceptable than a stricter limit of 110 km/h. The results derived from the multinomial and binary logistic regression models support the fact that attitudes toward risk and driver attributes play a critical role in the respondent's decision.

Acceptance is significantly influenced, in particular, by personal driving experiences and beliefs about road safety. If a driver has never been in a serious crash or if they underestimate the number of traffic crashes that happen in Greece each year, they are less likely to support a lower speed limit. This showcase the general lack of safety awareness and driving culture in the specific data sample. Respondents who have been in crashes that resulted in injuries or who voice concerns about traffic risk are more likely to support lowering the speed limit

On the economic front, the Cost-Benefit Analysis supports the policy's feasibility, particularly the reduction to 110 km/h. Significant financial and environmental savings result from the intervention, which is linked to a 16% decrease in fuel consumption despite an estimated 14.91% increase in travel time. Significant drops in harmful emissions, such as CO_2 , NOx, and PM, are noted, which is in line with Greece's national sustainability agenda as well as EU climate targets. Additionally, the nation's Vision Zero goal of eradicating highway fatalities by 2030 is aided by advancements in traffic safety.

The initiative's strong economic performance is confirmed by the project's estimated €10.94 million Economic Net Present Value (ENPV) and 55.8% Internal Rate of Return (ERR).
In light of these findings, the research offers several policy recommendations. Firstly, since they are more likely to be embraced by the public, reform should start with modest speed reductions, particularly to 120 km/h. Secondly, any legislative or technical changes should be accompanied by focused public awareness campaigns that emphasize risk perception and the costs of traffic crashes to society. A more safety-conscious driving culture may be promoted by informing drivers about the connection between speed, the severity of crashes, and fuel consumption.

Finally, this research outlines potential points for future research. These include extending the study to more road segments across different regions, integrating real-world telematics and behavioral data, and exploring adaptive speed management systems that respond dynamically to traffic, weather, and road conditions. Such extensions might improve the predictive models' accuracy even more and provide evidence-based tools to policymakers to improve road safety and environmental performance throughout Greece's highway system.

In conclusion, the data from this research makes a strong case for lowering the speed limit, even though not all citizens currently agree with this idea—especially those who don't think the roads are dangerous. The introduction of such a policy as part of a larger sustainable mobility strategy is strongly supported by the socioeconomic and environmental benefits and opportunities of public engagement.

5. References-Bibliography

Agourou, Ch. (2023). A study on the acceptance of speed limit reduction on Greek motorways from 130 km/h to 110 km/h. Athens: National Technical University of Athens (NTUA).

Automobile Club Sandorio. (2018). Incidenti Stradalli in Italia Raporto ACI- ISTAT 2018. Instituto Nazionale di Statistica.

Benthem, A. v. (2015). What is the optimal speed limit on freeways? Journal of Public Economics, 124, σσ. 44-46. doi:10.1016/j.jpubeco.2015.02.001

Daniels, S., H.Martensen, Schoeters, A., Berghe, W. V., Papadimitriou, E., Ziakopoulos, A., O. Martin Perez. (2019, December). A systematic cost-benefit analysis of 29 road safety measures. Accident analysis and prevention, 133. doi:10.1016/j.aap.2019.105292

ECMT. (2006). Speed Managment. European Conference Of Ministers Of Transport. OECD Publishing. doi:https://doi.org/10.1787/9789282103784-en.

ELSTAT. (2023). Retrieved from Hellenic Statistical Authority: https://www.statistics.gr/en/statistics/-/publication/SDT03/-

Elvik, R. (2013). A re-parameterisation of the Power Model of the relationship between the speed of traffic and the number of accidents and accident victims. Accident Analysis & Prevention, 50, 854-860. doi:https://doi.org/10.1016/j.aap.2012.07.012

European Commission. (2021). Economic Appraisal Vademecum 2021-2027 - General Principles and Sector Applications. Brussels: European Union. https://ec.europa.eu/regional_policy/sources/guides/vademecum_2127/vademecum_2127_en.pdf

Finch, D. J., Kompfner, P., Lockwood, C., & Maycock, G. (1994). Speed, Speed Limit and Accidents. https://discovery.nationalarchives.gov.uk/details/r/C5188213

Gaffney, J., & Hovenden, E. (2023). New Understanding of Motorway Crash Risk From Newly Available Metrics. Journal of Road Safety, 34(2), 46-62. doi:https://doi.org/10.33492/JRS-D-22-00027.

Georgiadou, E. (2014). Investigation of the impact of increasing the speed limit on road safety on motorways. National Technical University of Athens (NTUA).

Hosseinloui, M. H., Kheyrabadi, S. A., & Zolfaghari, A. (2015, July). Determining optimal speed limits in traffic networks. IATSS Research, 39(1), 36-41. doi:https://doi.org/10.1016/j.iatssr.2014.08.003

Hoye, A., Elvik, R., Vaa, T., & Sorensen, M. (2009). The Handbook of Road Safety Measures (2η εκδ.). Emerald Group Publishing Limited. doi:ISBN: 1848552505, 9781848552500

ITF. (2023). Road Safety Annual Report 2023. IRTAD, International Transport Forum. Paris: OECD. doi:https://doi.org/10.1787/8654c572-en

Olympia Odos. (2023). Sustainable Development Report. Athens: Olympia Odos.

Montella, A., Andreassen, D., Tarko, A. P., Turner, S., Mauriello, F., Imbriani, L. L., & Romero, M. A. (2013). Crash Databases in Australasia, the European Union, and the United States: Review and Prospects for Improvement. Transportation Research Record, 2386(1). doi:https://doi.org/10.3141/2386-15

NHTSA. (2015). Crash Data Key Findings. Washngton: National Center for Statistics and Analysis.

Nilsson, G. (2004). Traffic Safety Dimensions and the Power Model to Describe the Effect of Speed on Safety. Lund Institute of Technology and Society, Department of Technology and Society. https://lucris.lub.lu.se/ws/portalfiles/portal/4394446/1693353.pdf

NRSO. (2022). National Technical University of Athens, Road Safety Observatory, Athens. https://www.nrso.ntua.gr/nrss2030/wp-content/uploads/2022/10/Baseline-2022Counts.pdf

NRSO. (2023). ec2. Fatalities by Road Crash Type- Ranking of European Union Member States, 2021. National Technical University of Athens , Road Safety Observatory, Athens. Ανάκτηση από https://www.nrso.ntua.gr/nrso-ec2/

Sartori, D., Catalano, G., Genco, M., Pancotti, C., Sirtori, E., Vignetti, S., & Del Bo, C. (2014). Guide to Cost-Benefit Analysis- Economic Appraisal Tool for Cohension Policy 2014-2020. European Commision. doi:10.2776/97516

Sliogeris, J. (1992). 110 kilometre per hour speed limit : evaluation of road safety effects. Vic Roads (Firm).

Tarko, A. P., Pineda-Mendez, R., & Guo, Q. (2019). Predicting the Impact of Changing Speed Limits on Traffic Safety and Mobility on Indiana Freeways. Indiana Department of Transportation and Purdue University, Joint Transportation Research Program, Indianapolis. doi:10.5703/1288284316922

Yannis, G., Laiou, A., Dragomanovits, A., Nikolaou, D., Folla, K., Michelaraki, E., . . . Parissis, M. (2023). Development of the road safety strategic plan in Greece, 2021-2030. Transportation Research Procedia, 72, 256-262. doi:https://doi.org/10.1016/j.trpro.2023.11.402

Yannis, G., Papantoniou, P., & Georgiadou, E. (2015). Investigation of the impact of increasing the speed limit on road safety on motorways. School of Civil Engineering, Department of Transportation Planning and Engineering. Athens: National Technical University of Athens (NTUA).