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HOW A LEGISLATIVE POLICY IN SPAIN HAS REDUCED TRAFFIC DEATHS AND INCREASED CITIZEN HAPPINESS

Abstract. This work evaluates the impact of the legislative policy of Royal Decree 970/2020, published on November 11, 2020, in the Official State Gazette (BOE). This reform aims to create a road safety model for reducing accidents in urban areas in Spain, aligned with European Union policy and World Health Organization recommendations, with the goal of reducing the number of fatalities and serious injuries in traffic accidents. The speed limit measures of 20 km/h, 30 km/h, and 50 km/h have been implemented in 60% of urban roads in total. To carry out the evaluation, a cost-benefit analysis is applied to quantify the results obtained from the impact of the implemented policy. The established speed limit measures have increased road safety and reduced accidents in urban areas in Spain in 2022.

Keywords: traffic accidents, cost-benefit analysis, speed, accident costs, urban areas

1. Introduction.

Traffic accidents in developed countries are considered one of the main problems. In 2017, a total of 509 people died in Spanish cities. Of these people, 80% corresponded to the group of users that make up the so-called vulnerable collective (pedestrians, cyclists, motorcyclists, and moped users). Experience has shown that speed reduction has a direct effect on reducing the accident rate of vulnerable road users without increasing traffic congestion; motor vehicles in their urban journeys do not exceed average speeds that are generally higher than 20 km/h in urban centers. (BOE No. 297, 2020). According to BOE No. 297, the risk of dying because of being run over is reduced by at least 5 times if the speed of the impacting vehicle is 30 km/h compared to one traveling at 50 km/h. Therefore, the speed of transport is directly related to the possible damage to the health of the person hit.

Because of the above, Article 50 of the General Traffic Regulations has been modified through the legislative policy Royal Decree 970/2020, establishing speed limit measures of 20 km/h, 30 km/h, and 50 km/h on 60% of urban roads in total. According to BOE No. 297, changes in the general regulations for urban traffic have been implemented to achieve a positive impact on reducing road accidents, especially in vulnerable groups. In addition, it ensures achieving fluidity in travel on major city avenues and reducing the negative impact on air quality in cities.

To carry out the assessment of the impact of the implemented policy and verify if the objectives stated in the national official gazette have been met, this study applies cost-benefit analysis with before-after evaluation of the costs associated with traffic accidents. The study uses road accident data from the statistical yearbooks of accidents from the Directorate General of Traffic (DGT). The external costs that are essential to quantify the size of the impact of vehicle use are calculated according to the INFRAS study (2004).

The legislative policy came into force on January 2, 2021; the years that corresponded to carry out the before-after evaluation are 2020 and 2021. However, these years have been discarded due to the possible bias of influence from the COVID-19 pandemic of 2020-2021. Consequently, the years selected for the before-after evaluation are 2019 and 2022, which are closest to the years of implementation of Royal Decree 970/2020 to avoid probable influences.

This work is divided into 3 sections. Section 2 analyzes the methodology for evaluating the impact of legislative policy. Section 3 performs the cost-benefit analysis of the impact and the before-after evaluation of the results after implementing the Royal Decree. Additionally, in the same part, the results are presented by municipalities in Spain in the Benefit/Cost ratio (2022/2019). Finally, conclusions are observed according to the evaluation results in section 4.

2. Methodology.

Despite the complexity of assessing the costs associated with traffic accidents, it is necessary to quantify the overall impact on a country's economy to evaluate the possible benefit of prevention policies. This impact is represented by the value of a good that has been destroyed by a road accident: years of life generating income and consumption for the economy; the well-being lost by someone being seriously injured; administrative costs (police, judge, etc.), material and health damages related to the accident. All the components mentioned above constitute the social cost of an accident.

On the other hand, it is necessary to include costs that are derived from the use of vehicles: air and noise pollution, climate change, and other factors not included in the previous ones. These costs are referred to in the study as external costs associated with accidents.

Upon obtaining the values of the costs associated with road accidents, cost-benefit analysis (De Rus, 2004) is used with the before-after method to compare the results of accident rates before and after the implementation of public policy.

2.1. Cost-benefit analysis

Cost-benefit analysis is a tool to compare the benefits of a policy with its associated costs. This method helps to make informed decisions and maximize benefits while minimizing risks. To do this, all costs associated with traffic accidents are calculated in the years before and after the implementation of the legislative policy. Consequently, the net benefit is quantified by subtracting costs from benefits, and the cost-benefit ratio is calculated through the formula B/C = NPV/PVC, where

NPV - the net present value of the total net benefits obtained by implementing the policy,

PVC - the present value of the costs of investment in the implemented policy.

Under simplifying conditions, the NPV and PVC tend to be approximately their annual value divided by the discount rate i (Pereira, 2008).

$$NPV = \frac{B}{1+i} + \frac{B}{(1+i)^2} + \frac{B}{(1+i)^3} + \cdots \approx \frac{B}{i},$$

$$PVC = \frac{C}{1+i} + \frac{C}{(1+i)^2} + \frac{C}{(1+i)^3} + \cdots \approx \frac{C}{i},$$

where i – the discount rate.

$$\frac{B}{C} = \frac{B/i}{C/i}$$

2.2. Estimation of the social cost of accidents.

To evaluate public policies implemented in the field of road safety using cost-benefit analysis, it is necessary to quantify the overall impact represented by the monetary value of destruction in traffic accidents. According to FITSA's (2008) classification, the components for calculating the benefit associated with the prevention of traffic accidents are administrative costs, medical costs and material damages, costs associated with victims, and production losses

To quantify the costs associated with accident victims, the following values are used:

- Value of Statistical Life (VSL) (reflects the maximum sum of benefits that a life could contribute to a given society).
- Monetary valuations of health losses associated with minor and serious injuries (these represent the monetary value of non-fatal injuries).
- Quality-Adjusted Life Year (QALY): This includes the monetary value quantifying health losses experienced by accident victims in a unit that combines quality and lifetime.

According to Abellán Perpiñán et al. (2011), the Value of Statistical Life (VSL) reflects the maximum sum of benefits that a life could contribute to a given society. De Blaeij et al. (2004) state that human losses are associated with 50% to 90% of fatal traffic accidents. In the research conducted by Abellán Perpiñán et al. (2011), the VSL was estimated analogously to Carthy et al. (1999) through the application of the so-called Chained Contingent Valuation/Standard Gamble Method. To calculate the benefit of accident prevention in the case of a fatality, medical and ambulance costs are added to obtain a Value of Preventing a Fatality (VPF).

Another human cost of a traffic accident is a seriously or slightly injured victim. To quantify the Monetary Value of a Non-Fatal Victim (MVNFV), it is necessary to reflect the maximum amount of money that society is willing to pay to reduce the rate of injuries (WTP). Additionally, costs associated with loss of production and medical expenses must be added to conclude the Value of preventing a serious or minor injury (VPSI and VPMI respectively).

Administrative costs reflect the expenses associated with the work of police, judges and lawyers, and insurance companies in managing accidents. In this study, administrative costs are not included due to the scarcity of data.

Material damages include the costs of repairing vehicles involved in accidents plus the costs of repairing damages caused to roads. According to UNESPA data, the average value of material damages associated with traffic accidents is 962 euros for the year 2021.

Social cost	Value, euro/unit	
	2011	2021
VSL (Value of Statistical Life)	1.300.000	1.447.232
VPF (Value of Preventing a Fatality)	1.400.000	1.558.557
Monetary valuation of health losses associated with minor injuries (MVHLaMI)	5.000	5.566
Value of preventing a minor injury (VPMI)	6.100	6.791
Monetary valuation of health losses associated with serious injuries (MVHLaSI)	183.500	199.357
Value of preventing a serious injury (VPSI)	224.411	243.803
QALY (Quality-Adjusted Life Year)	53.600	64.320
Material damages		962

Table 1. The cost associated with traffic accidents involving victims, Spain. Source: Statistical Yearbook 2021; Abellán Perpiñán et al. (2011).

2.3. Estimation of the external costs of accidents.

To quantify the total external costs of vehicle use, excluding congestion costs, data from the INFRAS (2004) study was used. Percentages were used to reflect the contribution of each impact component to total costs minus congestion. In urban areas, the impact of vehicle use is explained through the following components: noise and air pollution, climate change, and other urban effects.

In cities, traffic is the main source of air pollution. Emissions of carbon dioxide, nitrogen oxides, and harmful particles are responsible for global warming and human health damage. However, for particles and nitrogen dioxide, their negative effect decreases depending on the emission location and does not add to other emissions as occurs with carbon dioxide. Vehicle speed is related to greenhouse gas emissions (GHG, mainly carbon dioxide) and local pollutants (carbon monoxide, nitrogen oxides, and harmful particles). Nitrogen oxide emissions decrease with speed reduction. However, particle emissions may increase when reducing speed due to poorer combustion at lower temperatures or due to congestion in urban areas.

Noise pollution affects citizens' well-being and health, causing stress-related diseases, sleep disturbances, anxiety, etc. According to the Ministry of Health, noise is the second most important factor of environmental disease burden in Europe, only after air pollution. The importance of this component increases over time due to urban growth and increased citizen mobility demand.

Other components of external costs are urban effects such as loss of green spaces, waste management, light pollution, etc. For these and other previously mentioned issues, it is important to include the direct and indirect expenses caused by vehicle use in urban areas of a city. Therefore, the value of an accident consists of the sum of social and external costs associated with a road accident and its victims.

Table 2 presents the percentages of external costs associated with traffic accidents (social cost 100%). By quantifying social costs, monetary values of external costs related to accidents are obtained.

Component of cost	%
Social cost of accidents	100
Noise pollution	25,9
Air pollution	105,6
Climate change	72
Urban effects	6,3

Table 2. Percentages of social and external costs associated with traffic accidents involving victims.
Source: Own elaboration based on INFRAS (2004).

3. Cost-benefit "before-after" study of the legislative policy of Royal Decree 970/2020, published on November 11, 2020 in the Official State Gazette (BOE).

The legislative policy came into force on January 2, 2021; the years that corresponded to carry out the before-after evaluation are 2020 and 2021. However, these years have been discarded due to the possible bias of influence from the COVID-19 pandemic of 2020-2021. Consequently, the years selected for the before-after evaluation are 2019 and 2022, which are closest to the years of implementation of Royal Decree 970/2020 to avoid probable influences. Table 3 presents the components of social costs and material damages associated with traffic accidents that occurred in 2019 in monetary values for the year 2021.

	Quantity	VPH total, €	VPMI total, €	VPSI total, €	QALY total, €	Material damages total, €
Fatalities	519	808.891.083				
Serious injuries	4.310			1.050.790.930	277.219.200	
Minor injuries	79.338		538.784.358			
Material damages	66.741					64.204.842
			Total accidents in 2019:			**2.739.890.413**

Table 3. Calculation of the social cost associated with traffic accidents involving victims in 2019 (base year 2021, euros), Spain. Source: Own elaboration based on Statistical Yearbook of Accidents 2019 and 2021, DGT; unespa.es.

According to Table 3, the costs of accidents in 2019 amount to 2.739.890.413 euros, which is considered as the lost benefit due to road accidents.

Table 4 presents the components of social costs and material damages associated with traffic accidents that occurred in 2022 in monetary values for the year 2021.

	Quantity	VPH total, €	VPMI total, €	VPSI total, €	QALY total, €	Material damages total, €
Fatalities	473	737.197.461				
Serious injuries	4.610			1.123.931.830	296.515.200	
Minor injuries	74.530		506.133.230			
Material damages	64.616					62.160.592
			Total accidents in 2022:			**2.725.938.313**

Table 4. Calculation of the social cost associated with traffic accidents involving victims in 2022 (base year 2021, euros), Spain. Source: Own elaboration based on Statistical Yearbook of Accidents 2021 and 2022, DGT; unespa.es.

According to Table 4, the costs of accidents in 2022 amount to 2.725.938.313 euros, which is considered as the lost benefit due to road accidents.

Table 5 presents the components of external costs and social costs (including material damages) associated with traffic accidents that occurred in 2019 and 2022 in monetary values for the year 2021.

Component of cost	%	2019	2022
Social cost of accidents	100	2.739.890.413	2.725.938.313
Noise pollution	25,9	709.631.617	706.018.023
Air pollution	105,6	2.893.324.276	2.878.590.859
Climate change	72	1.972.721.097	1.962.675.585
Urban effects	6,3	172.613.096	171.734.114
Total social and external costs associated with traffic accidents:		**8.488.180.499**	**8.444.956.894**

Table 5. Calculation of social and external costs associated with traffic accidents involving victims in 2019 and 2022 (base year 2021, euros), Spain. Source: Own elaboration based on Statistical Yearbook of Accidents 2019, 2021 and 2022, DGT; unespa.es, INFRAS (2004).

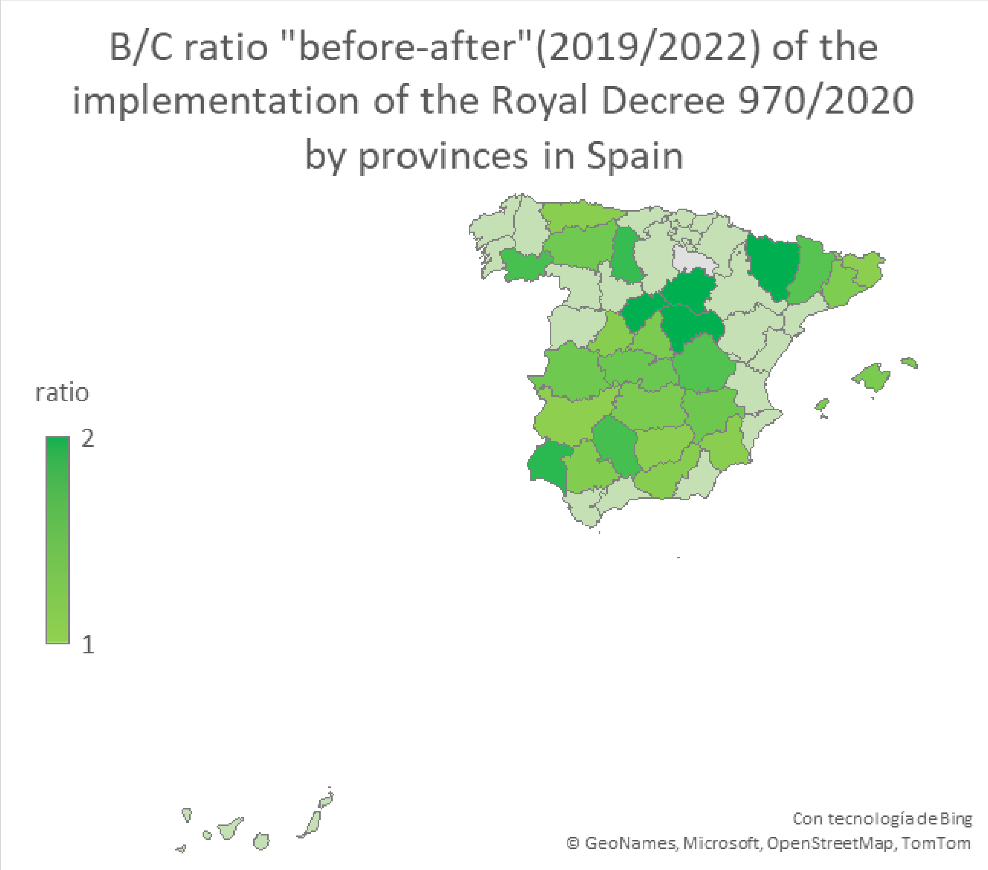
According to Table 5, the social and external costs of accidents in 2019 amount to 8.488.180.499 euros, and in 2022 – 8.444.956.894 euros. For the before-after cost-benefit calculation, the total costs (social and external) of accidents in 2019 are considered as the benefit; the total costs (social and external) of accidents in 2022 are considered as the cost.

$$\frac{B}{C} = \frac{2019}{2022} = \frac{8.488.180.499}{8.444.956.894} = 1{,}005 > 1$$

The result of the cost-benefit analysis indicates the viability of the implemented policy: a positive effect is observed. To visualize the effect of Royal Decree 970/2020, B/C ratios have been calculated for all Spanish provinces, which can be observed in Graph 1 and Table 6.

Araba/Álava	Albacete	Alicante/Alacan	Almería	Ávila	Badajoz	Balears (Illes)
0,901552755	1,243584364	0,971474226	0,691524718	1,08148162	1,026696425	1,159704787
Barcelona	Burgos	Cáceres	Cádiz	astellón/Castell	Ciudad Real	Córdoba
1,139774532	0,572051611	1,241092435	0,944524183	0,677010018	1,161499341	1,527102305
Coruña (A)	Cuenca	Girona	Granada	Guadalajara	Gipuzkoa	Huelva
0,799030822	1,437680554	1,047548136	1,080456318	2,680101471	0,766175795	1,719106593
Huesca	Jaén	León	Lleida	Rioja (La)	Lugo	Madrid
2,219439058	1,044269526	1,230327719	1,40442007	0,941539255	0,905022364	1,159231938
Málaga	Murcia	Navarra	Ourense	Asturias	Palencia	Palmas (Las)
0,976644978	1,054588299	0,937383737	1,509941229	1,058065337	1,632145698	0,845142968
Pontevedra	Salamanca	Santa Cruz de Tenerife	Cantabria	Segovia	Sevilla	Soria
0,927382956	0,288957829	0,987485214	0,51757654	4,190933006	1,110267631	3,385148172
Tarragona	Teruel	Toledo	alencia/Valènci	Valladolid	Bizkaia	Zamora
0,95104216	0,192381547	1,273287137	0,691238455	0,671349423	0,83617418	0,878918946
Zaragoza	Ceuta	Melilla				
0,746115604	1,877966487	0,639208857				

Table 6. B/C ratio of the implementation of the legislative policy Royal Decree 970/2020 by provinces in Spain. Source: Own elaboration based on Statistical Yearbook of Accidents 2019, 2021 and 2022, DGT; unespa.es, INFRAS (2004).



Graph 1. B/C ratio of the implementation of the legislative policy Royal Decree 970/2020 by provinces in Spain. Source: Own elaboration based on Statistical Yearbook of Accidents 2019, 2021 and 2022, DGT; unespa.es, INFRAS (2004).

Graph 1 shows in which provinces the modification of traffic regulations has had a positive effect. The results obtained allow us to conclude the effectiveness of the implemented policy and its positive effect in most of Spain. However, a null effect of Royal Decree 970/2020 is observed in one-third of the Spanish territory, which requires additional measures to ensure compliance by citizens with the implemented regulations.

4. Conclusions

The costs of traffic accidents in Spain in 2022 oscillate around the value of almost 8.445 million euros. These costs represent a significant burden for Spanish society. However, the results obtained indicate a positive trend in the modification of Article 50 of the General Traffic Regulations through the legislative policy Royal Decree 970/2020, establishing speed limit measures of 20 km/h, 30 km/h, and 50 km/h in 60% of urban roads in total. Overall, the legislative policy has had a positive effect in most Spanish provinces. In areas where the implemented measures have not achieved the expected effect, additional policies need to be implemented through public administration investments to guarantee and improve road safety in urban areas.

According to data from the World Health Organization, the situation in Europe is positive as the mortality rate from traffic accidents is decreasing. Furthermore, speed has a direct relationship with the survival of pedestrians in collisions (OECD and ITF, 2011). In a pedestrian collision at 48 km/h, 45% of pedestrians die, while at 32 km/h, only 5% die (ETSC, 1995)3. According to Nilsson's "Power Model" (2004), reducing the average speed by 5% decreases injury accidents by 10% and fatal accidents by 20%. Studies from the University of Valencia on major sources of pollution indicate that there is no optimal speed for reducing pollution, but rather a range of speeds to avoid accelerations and decelerations.

In conclusion, according to traffic accident studies, the importance of speed control is evident, as excessive speed is the major cause of road accidents. For this reason, all measures that tend to reduce speed, such as the modification of the General Traffic Regulations, speed bumps, fixed and mobile radars, have good effectiveness in preventing road accidents. However, according to data from countries with speed limit 30 km/h of urban areas, the impact of the new road traffic model achieves its greatest positive effect in the long term. Therefore, it is necessary to implement additional policies through public administration investments to guarantee and improve road safety in urban areas in the short term, with the introduction of periodic evaluations to identify the achieved objectives of the implemented programs.

References

1. AEC (2006): Libro Verde de la Seguridad Vial. Asociación Española de la Carretera;Madrid
2. Alfaro, J.L.; Chapuis, M.; Fabre, E. (eds.) (1994): COST 313.Le coût socioéconomique des accidents de la route. Luxembourg; Office des Publications des Communautés Européennes.
3. Alvarez, O.; Cantos P. y R. Pereira (2007): “Precios óptimos en el transporte interurbano por carretera”. Revista de Economía Aplicada (en prensa), pp. 1 a 28,
4. Anuario estadístico de accidentes, DGT, 2019
5. Anuario estadístico de accidentes, DGT, 2021
6. Anuario estadístico de accidentes, DGT, 2022
7. Bless; I. B. (2000): “Killing speed”, Injury Prevention, pp. 163-165.
8. Chisvert, M.J. (2000): Calidad y representatividad de los datos de accidentes de tráfico: Revisión, estudio del caso español y desarrollo de propuestas para la mejora de los sistemas de recogida y tratamiento de información sobre accidentalidad. Tesis Doctoral. Universidad de Valencia
9. Christie, S.M., Lyons, R.A., Dusten, F. D. y Jones, S. J. (2003): “Are mobile speed cameras effective? A controlled before and after study”. Injury Prevention, pp.302-306
10. Comisión Europea (2000): Prioridades de la seguridad vial de la UE. Informe de la situación y clasificación de acciones. COM (2000) 125 final. Bruselas: Comisión Europea.

11. Comisión Europea, (2001): Libro Blanco. La política de transportes de cara al 2010: La hora de la verdad. COM 2001-370 final. Bruselas; Comisión de las Comunidades Europeas.
12. Corbett, C. (1995): “Road traffic offending and the introduction of speed cameras in England: the first self-report survey”, Accident Analysis and Prevention, vol. 27,nº3, pp. 345-354.
13. De Blaeij, A.; Florax, R.; Rietveld, P.; Verhoef, E. (2003): “The Value of statistical Life in road Safety: a Meta-Analysis”. Accident Analysis and Prevention, vol. 35, nº 6, pp. 973-986.
14. De Rus, G. (2004): Análisis coste-beneficio, 2ª edición, Barcelona: Ariel. Dirección General de Tráfico, (varios años) : Anuario Estadístico de Accidentes. Madrid, Dirección General de Tráfico.
15. Dings, J.M.W., P. A. Janse, B. A. Leurs y M.D. Davidson (1999): Efficient prices for transport – Estimating the social costs of vehicle use, Delft, CE
16. Dings, J.M.W., M.D. Davidson y M. N. Sevenster (2003): External and infrastructure costs of road and rail traffic – analysing European studies, Delft, CE
17. ECMT (1998): Efficient Transport for Europe. Policies for Internalisation of External Costs. Paris, OECD Publications.
18. ECMT (2006). Gestión de velocidad. Recuperado el 29 de enero de 2015 de http://www.internationaltransportforum.org/Pub/pdf/06SpeedES.pdf
19. Elvik, R. (2000): “How much do road accidents cost the national economy”. Accident Analysis and Prevention, vol. 32-6, pp. 849-851.
20. Elvik, R. (2001): “Cost benefit analysis of road safety measures: applicability and controversies”. Accident Analysis and Prevention, vol. 33-1, pp. 9-17.
21. Elvik R. y T. Vaa (eds.) (2004): The Handbook of Road Safety Measures. Amsterdam, Elsevier.
22. ETSC, (1997): Transport Accidents Costs and the Value of Safety. Brussels:European Transport Safety Council.
23. Gómez-Ibañez, J. y J. Meyer (1993): Going private: the international experience with transport privatization. The Brookings Institution, Washington, D.C.
24. INE (varios años): Anuario Estadístico de España. Instituto Nacional de Estadística.
25. INFRAS/IWW (2000): External Cost of Transport. UIC
26. INFRAS/IWW (2004): External Cost of Transport. Update Study. Final Report. Zurich/Karlsruhe.
27. INTRAS, Universidad de Valencia, “Zonas 30”
28. FITSA, El valor de la seguridad vial, 2008.
29. M. M. Morales Suárez-Varela García (l), A. García Rodríguez EVALUACION RESIDENTES DE LOS EFECTOS DEL RUIDO AMBIENTAL EN EL CENTRO HISTORICO SOBRE LOS DE VALENCIA, Rev.San Hig Pub.1992:239-244
30. Miller, T. D. (2000): “Variations between Countries in Values of Statistical Life”.
31. Journal of Transport Economics and Policy, volume 34, part 2, pp.169-188.

32. Nellthorp J, T. Sansom, P. Bickel, C. Doll y G. Lindberg (2001): Valuation Conventions for UNITE, UNITE (Unification of accounts and marginal costs for Transport Efficiency). Deliverable 5 Annex 3, ITS, University of Leeds, Leeds.
33. Nilsson, G. (2004). Traffic safety dimensions and the Power Model to describe the effect of speed on safety. Bulletin 221. Lund Institute of Technology, Department of Technology and Society, Traffic Engineering, Lund
34. OCDE e ITF (2011). Peatones: seguridad vial, espacio urbano y salud. Resumen. Recuperado el 29 de enero de 2015 de http://www.internationaltransportforum.org/pub/pdf/11PedestrianSumES.pdf
35. OECD, (2002): Safety on roads. What´s the Vision?. Paris: OECD.
36. Peltzman, S. (1975): “The effects of automobile safety regulation”. Journal of Political Economy 83(4), pp.677-726
37. Pereira, R. (2005): "El coste social de los accidentes de tráfico en España". Carreteras, nº 142, pp. 64-76.
38. Pereira; R. (2007): “Aspectos económicos de los accidentes de tráfico en Galicia”, Revista Galega de Economía, vol. 16 nº 2, pp. 157-176.
39. Pilkington (2003): “Speed cameras under attack in the United Kingdom”, Injury Prevention, 9, 293-294.
40. Real Decreto 970/2020 publicado 11.11.2020: BOE-A-2020-13969.
41. UNESPA https://www.unespa.es/portal-de-transparencia/cuentas-anuales/
42. Trawen, A.; Maraste, P.; Persson, U., (2002): “International comparaison of costs of
a fatal casualty of road accidents in and 1999”. Accident Analysis and Prevention, vol.34, pp. 323-332.
43. Viscusi, W.K. (1993): “The Value of Risks to Life and Health”. Journal of Economic
Literature, Vol. XXXI, December 1993, pp. 1912-1946.
44. Viscusi, W. K. y J. E. Aldy (2003): “The Value of a Statistical Life: A Critical Review
of Markets estimates Throughout the World”. The Journal of Risk and Uncertainty, vol. 27:1, pp. 5-76.
45. West, R. (1998): “The effect of speed cameras on injuries from road accidents”. British Medical Journal, 316, pp. 5-6.
46. Zaragoza, A. (2005): “Teoría de la homeostasis del riesgo subjetivo”. Carreteras, nº142, pp. 21-34.