

Supplement

Cost-based Road Safety Dynamics Under an Exogenous Mobility Shock: Evidence from Interrupted Time Series and Difference-in-differences on Rural Roads

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1 General

The Supplement provides the accident cost parameters for B-roads (Table S1), RoadSTAR parameter descriptions (Table S2), and the variable specification matrix (Table S3). Additional robustness analyses include interrupted time series sensitivity estimates (Table S4),

placebo intervention tests (Table S5), and accident cost sensitivity estimates (Table S6). The accompanying figures illustrate quarterly Accident Cost Rate developments (Fig. S1), the placebo intervention comparison (Fig. S2), and event-study estimates (Fig. S3).

Table S1 UPS cost rates for B-roads (2011/2016/2021)

Year	Fatality (€)	Severe injury (€)	Slight injury (€)	Property damage (€)	Total per average PIC crash (€)	Source
2011	58,009	120,149	28,358	5,245	211,761	Herry Consult et al. (2012)
2016	53,713	85,500	34,958	5,463	179,634	Herry Consult and KfV (2017)
2021	73,339	123,298	48,563	6,450	251,650	Sedlacek et al. (2023)

Table S2 RoadSTAR parameter descriptions

Parameter	Description	Unit
StrCode	Road short code + direction	–
s (m)	Distance travelled	m
StrKM (km+m)	Last stationing marker + distance since marker	km+m
StrKM (km)	Stationing in decimal km	km
long (°)	Longitude (geographic coordinates)	deg
lat (°)	Latitude (geographic coordinates)	deg
μ (–)	1 m mean friction	–
T (°C)	1 m mean pavement surface temperature	°C
MPD (mm)	1 m macrotexture MPD	mm
IRI (–)	1 m IRI	–
Δ WLP (mm)	1 m longitudinal evenness Δ WLP	mm
σ WLP (mm)	1 m longitudinal evenness σ WLP	mm
bew_ Δ WLP (mm)	1 m evenness bew_ Δ WLP	mm
bew_ σ WLP (mm)	1 m evenness bew_ σ WLP	mm
WDepth (mm)	1 m max theoretical water depth in cross-section	mm
Depth2m (mm)	1 m max rut depth	mm
Cracks total (%)	Share of cracks (linear+area)	%
Surface defects total (%)	Share of surface defects	%
q (%)	Cross slope	%
s (%)	Longitudinal slope	%
R (m)	Curve radius	m
A (–)	Clothoid parameter	–
Curviness (–)	Curviness index (1 km window)	–
Date	Survey date [yymmdd]	date
Time	Survey start time [hhmm]	time
Work zone	Work zone (0 = no; 1 = yes)	0/1
KM adjusted (km)	Last km post + adjusted distance	km
Notes	Events during survey	text
ds-dKM (m)	Diff. between distance by markers and nominal distance	m

Table S3 Variable overview and specification matrix

Variable	Definition	Unit	Model use
road_id	Anonymous road ID	–	Descriptive/Panel
state	Federal state (A/B)	–	ITS/DiD grouping
year	Calendar year	year	All
month	Month (1–12)	month	All
total_cost_eur	Sum of accident costs in month [€]	€	ITS/DiD/Two-Part
adt_or_jdtv_veh_per_24h	ADT/AADT [veh/24h]	veh/24h	Exposure
length_km	Section length [km]	km	Exposure
veh_km_month	Vehicle-km in month	veh-km	Offset/ACR/AR
ukr_eur_per_1000_vehkm	Accident cost rate [€/1,000 veh-km]	€/1,000 veh-km	Descriptive
ur_per_million_vehkm	Accident rate [per million veh-km]	per million veh-km	Descriptive
accidents_month	Monthly crash count	#	NB/AR
accident_date	# date (YYYY-MM-01)	date	Index

Table S4 ITS sensitivity (−1 / 0 / +1; quarterly)

Variant	State	delta (level shift)	95% CI delta	p delta	gamma (trend)	95% CI gamma	p gamma
Window -1 (Feb 2020)	State A	4.474	[3.273, 5.675]	< 0.001	−0.008	[−0.043, 0.027]	0.647
Window -1 (Feb 2020)	State B	6.926	[1.965, 11.886]	0.006	−0.122	[−0.277, 0.033]	0.124
Baseline (Mar 2020)	State A	4.945	[3.860, 6.031]	< 0.001	−0.024	[−0.058, 0.011]	0.175
Baseline (Mar 2020)	State B	6.887	[1.481, 12.293]	0.013	−0.126	[−0.301, 0.049]	0.159
Window +1 (Apr 2020)	State A	4.663	[3.548, 5.778]	< 0.001	−0.017	[−0.052, 0.018]	0.342
Window +1 (Apr 2020)	State B	6.887	[1.481, 12.293]	0.013	−0.126	[−0.301, 0.049]	0.159
Quarterly aggregation	State A	4.316	[3.168, 5.464]	< 0.001	−0.011	[−0.095, 0.072]	0.793
Quarterly aggregation	State B	9.041	[5.789, 12.292]	< 0.001	−0.536	[−0.885, −0.188]	0.003

Note: Level-shift estimates (δ) are reported as positive magnitudes of estimated decreases. The corresponding signed regression coefficients are negative. Reported p-values refer to the original model estimates.

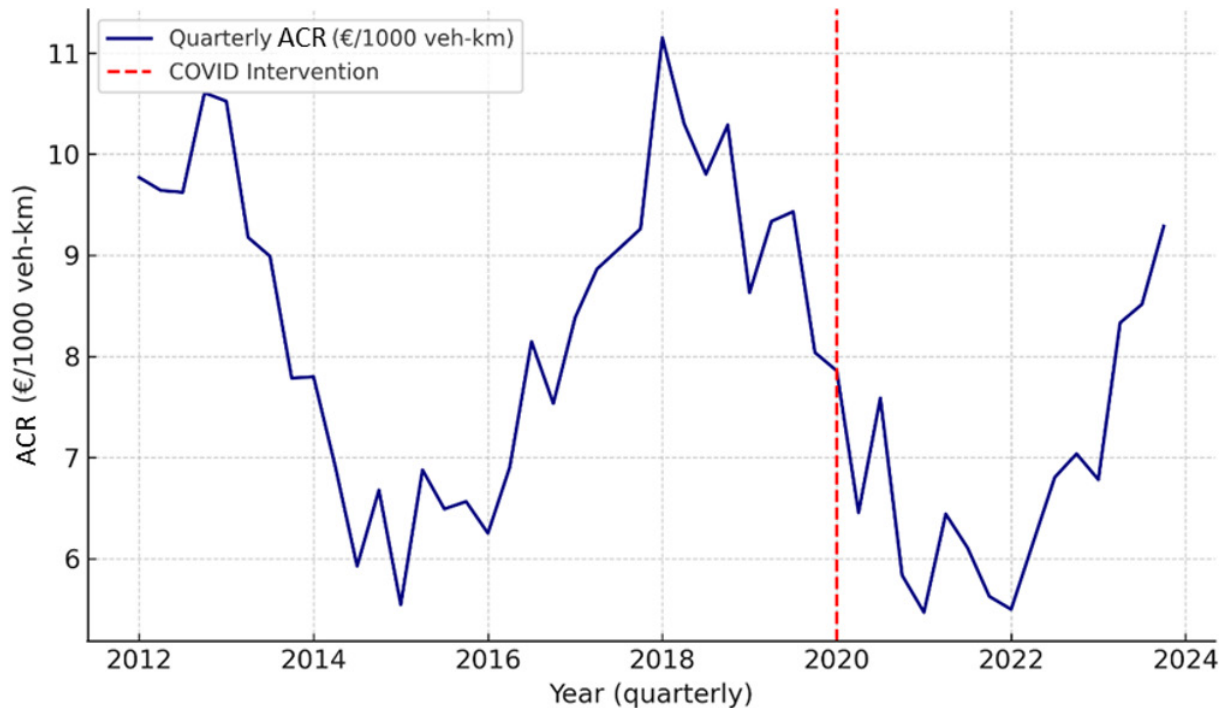
Table S5 Placebo cuts (2019-10; 2019-07)

Placebo date	State	delta (level shift)	95% CI delta	p delta	gamma (trend)	95% CI gamma	p gamma
2019-10	State A	3.870	[2.266, 5.474]	< 0.001	0.014	[−0.032, 0.059]	0.560
2019-10	State B	7.837	[3.335, 12.338]	0.001	−0.123	[−0.237, −0.009]	0.034
2019-07	State A	2.989	[0.732, 5.245]	0.009	0.037	[−0.023, 0.097]	0.229
2019-07	State B	6.578	[2.424, 10.733]	0.002	−0.076	[−0.176, 0.023]	0.134

Note: Level-shift estimates (δ) are reported as positive magnitudes of estimated decreases. The corresponding signed regression coefficients are negative. Reported p-values refer to the original model estimates.

Table S6 Costs $\pm 10\%$ sensitivity

Variant	State	delta (level shift)	95% CI delta	p delta	gamma (trend)	95% CI gamma	p gamma
Costs −10%	State A	4.451	[3.474, 5.428]	< 0.001	−0.021	[−0.052, 0.009]	0.175
Costs −10%	State B	6.198	[1.333, 11.063]	0.013	−0.113	[−0.271, 0.044]	0.159
Baseline	State A	4.945	[3.860, 6.031]	< 0.001	−0.024	[−0.058, 0.011]	0.175
Baseline	State B	6.887	[1.481, 12.293]	0.013	−0.126	[−0.301, 0.049]	0.159
Costs +10%	State A	5.440	[4.246, 6.634]	< 0.001	−0.026	[−0.064, 0.012]	0.175
Costs +10%	State B	7.575	[1.629, 13.522]	0.013	−0.139	[−0.331, 0.054]	0.159

**Fig. S1** Quarterly Accident Cost Rate (ACR), 2012–2023; intervention marked

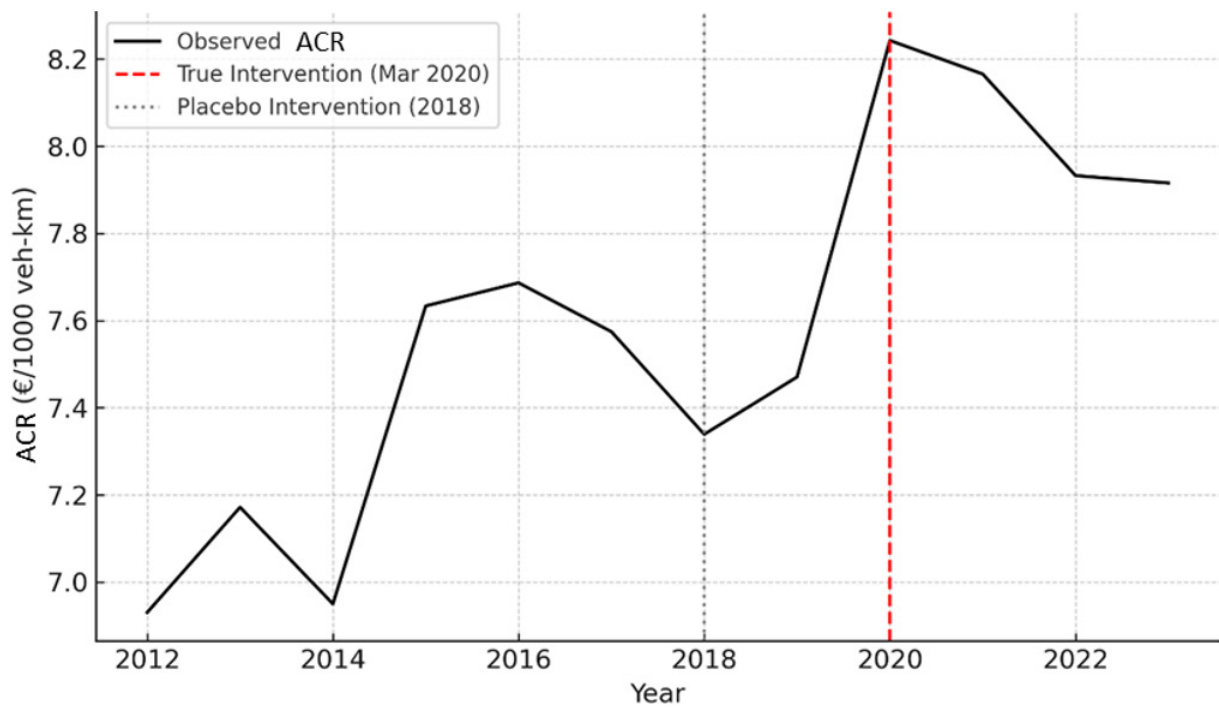


Fig. S2 Placebo Intervention Test (comparison with true cut)

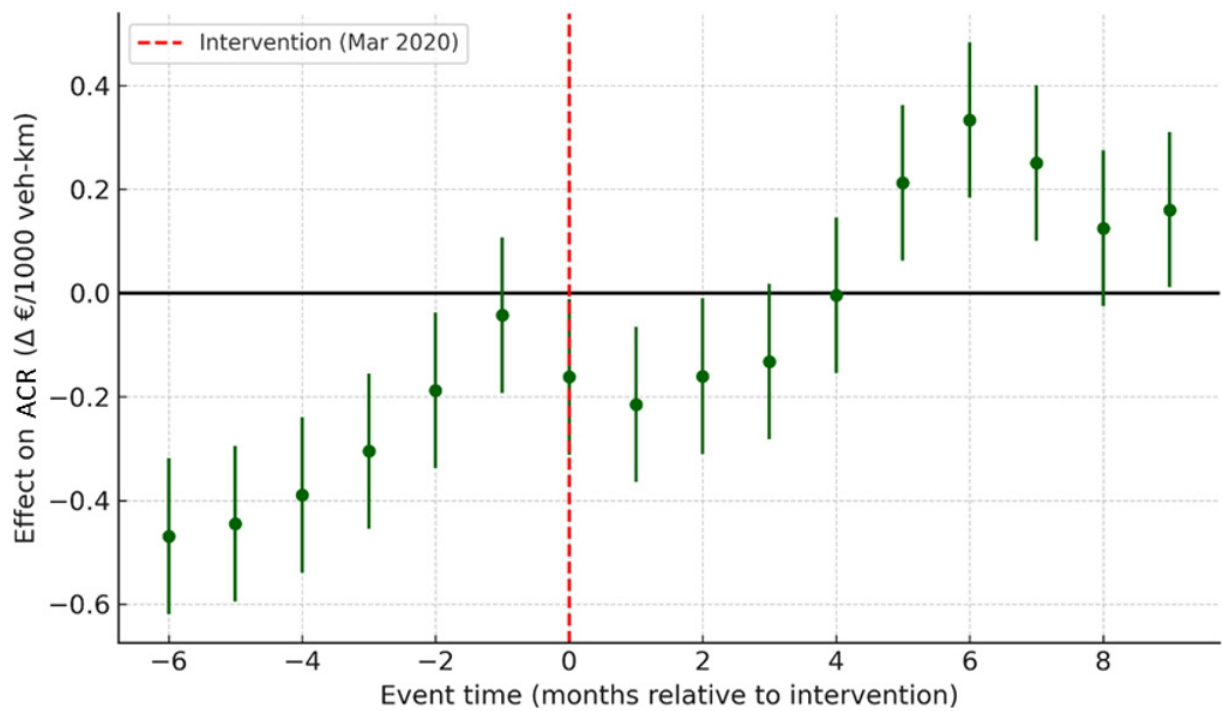


Fig. S3 Event-Study Estimates (95% CI)