On the marginal accident cost of road use

By

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Outline

1. Problem statement

- How does the number accidents depend on the amount of traffic, as measured, e g, in terms of vehicle kms travelled (VKT)?
- How is the risk affected by one additional vehicle entering the road?
- What is the marginal accident cost pertaining to, e g, light vehicles, heavy vehicles, and motorcycles?
- How large is the externality involved?
- How is the externality related to insurance?

2. Mathematical formalism
3. Empirical evidence
4. Summary
5. Discussion

Accident costs are not internalised through insurance

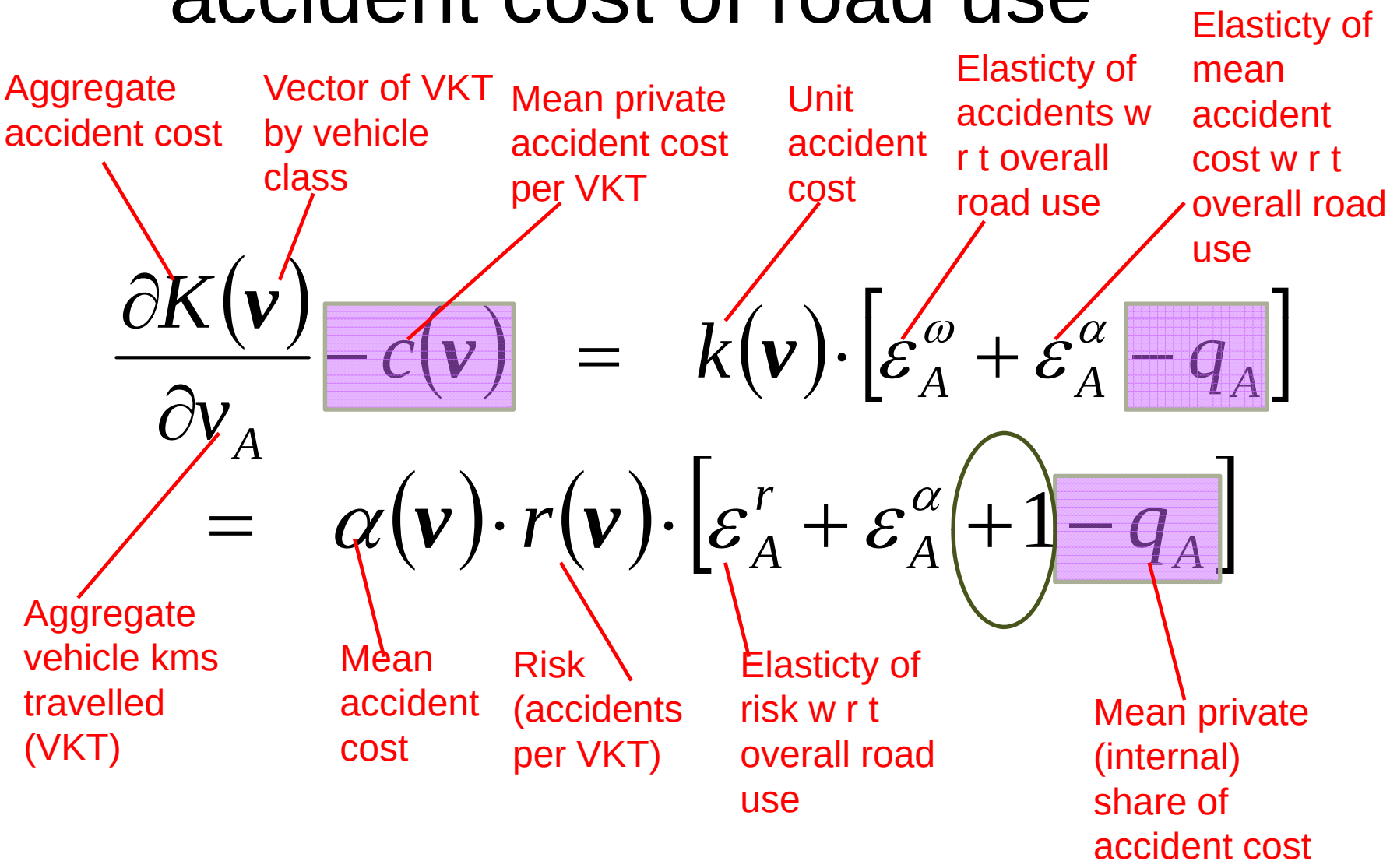
- They are, in fact, externalised.
- Although the club of road users may be seen to cover their accident costs through insurance premiums roughly balancing the damages paid, this is irrelevant.
- The individual road user is protected against large financial losses. Externalities operate at the disaggregate level.
- Without auto insurance, private car use would be an option only to the reckless, the risk lovers and the immensely rich.
- Only operators large enough to be self-insured could enter the market.

The basic decision: to drive

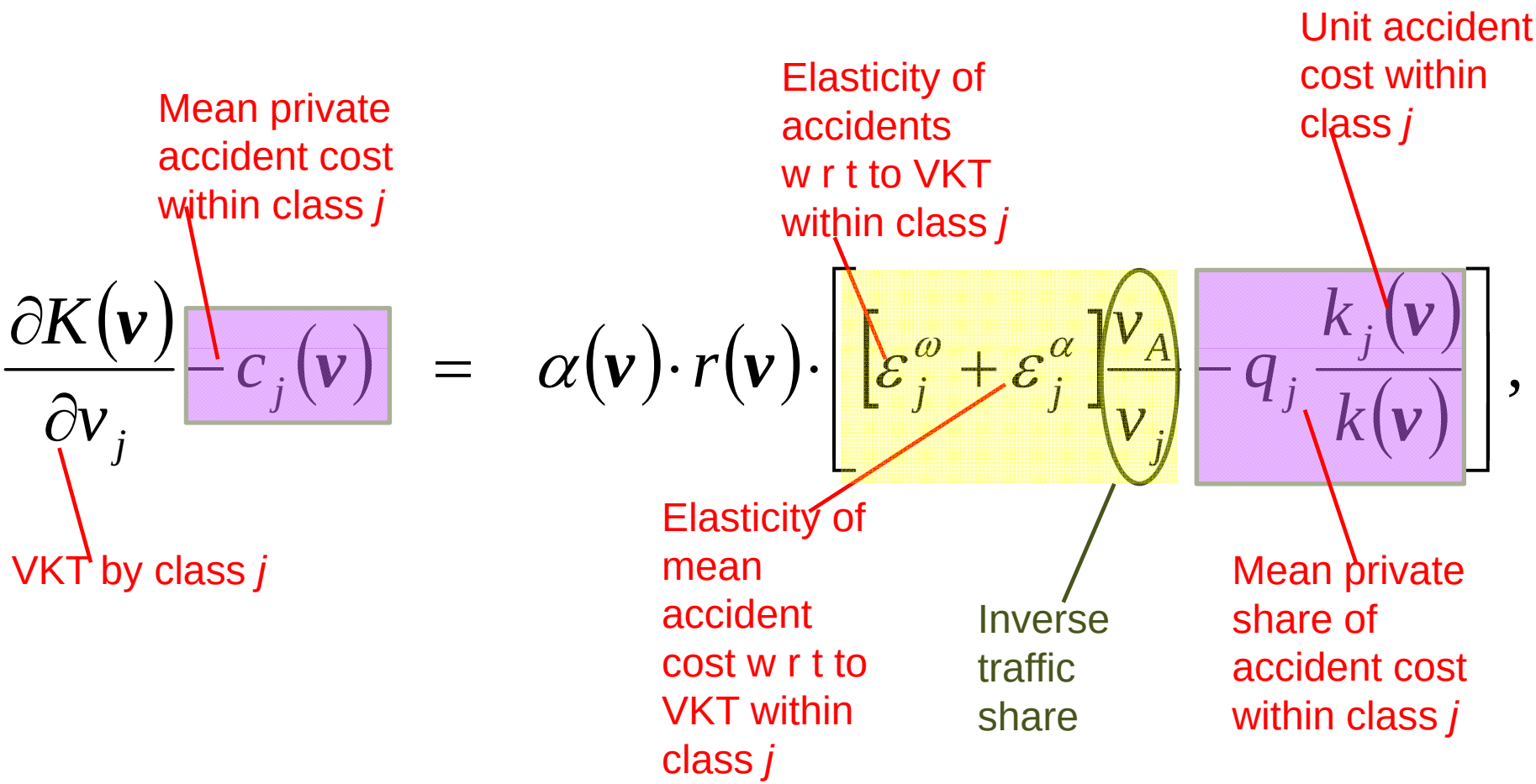
Road users also make a number of other choices:

- Vehicle type (age, mass, power, built-in safety devices, etc)
- Destination
- Route
- Time of day/week/year
- Speed
- Attention/distraction

Formalism: the marginal external accident cost of road use



In the multidimensional case:



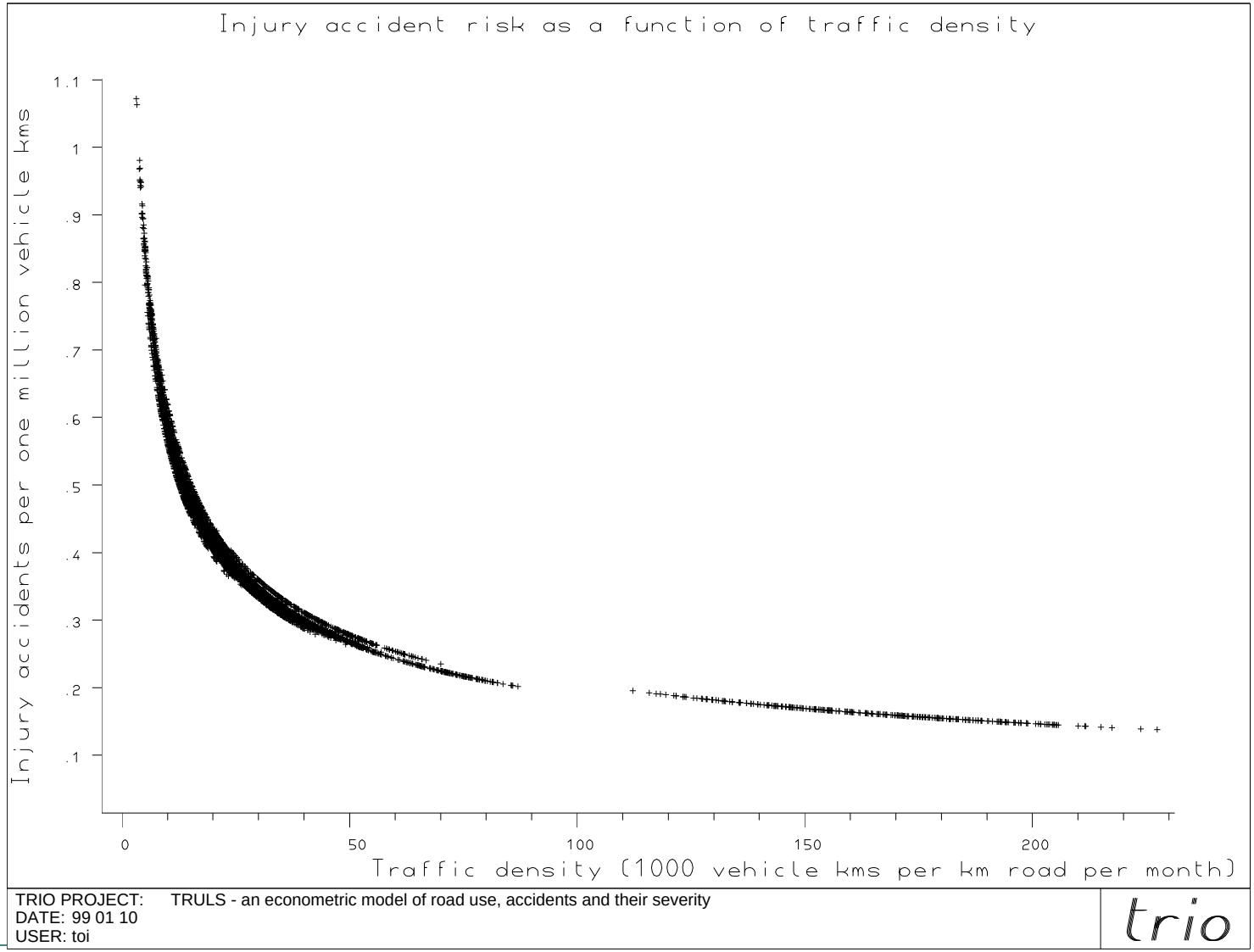
We need to evaluate the yellow part.

Table 1: Measures of partial association between injury accidents and overall, light vehicle and heavy vehicle road use, as estimated for Norwegian counties 1973-94. Minimal, mean and maximal sample point values. Source: Fridstrøm (1999, 2000a)

Traffic category	Elasticity			Inverse traffic share times elasticity		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum
Total vehicle kilometres	0.484	0.494	0.506	0.484	0.494	0.506
Light vehicle kilometres	0.248	0.291	0.361	0.335	0.345	0.357
Heavy vehicle kilometres	0.181	0.202	0.236	0.909	1.321	1.974

$$\varepsilon_A^r = \varepsilon_A^\omega - 1 \qquad \varepsilon_j^r = \varepsilon_j^\omega - \frac{v_j}{v_A}$$

Risk decreases with traffic density



Crucial thresholds

$$q_A - \varepsilon_A^{\alpha} < \varepsilon_A^{\omega} = 0.494$$

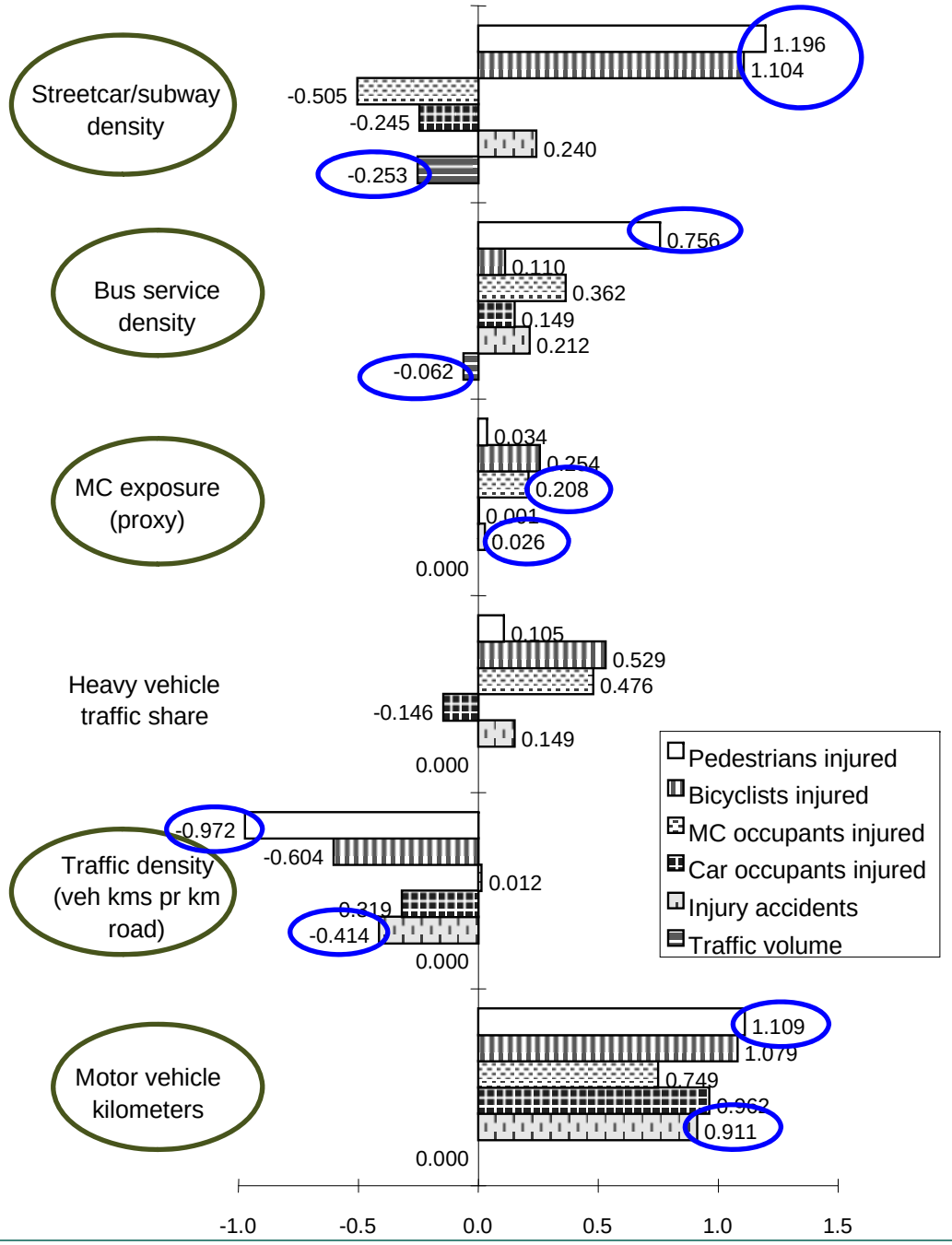
If the overall, internal accident cost share minus the mean cost elasticity is smaller than appr. one half, then the marginal external accident cost is positive.

Similarly for light and heavy vehicles, respectively:

$$q_L < \varepsilon_L^{\omega} = 0.345$$

$$q_H < \varepsilon_H^{\omega} = 1.321$$

Injury accident elasticity estimates for Norway 1994



Summary

- The accident risk is *not independent of the traffic volume*. It is a *decreasing* function of it.
- Hence, the *risk elasticity* with respect to road use is probably *negative*.
- There is probably a large, *positive* accident externality generated by heavy vehicle road use, while the marginal external accident cost of private car use is quite small, perhaps even *negative*.
- To the extent that it is positive, it is so, not in spite of auto insurance, but – at least partly – *on account of* it.
- Motorcycle use appears to be just as dangerous on the margin as heavy vehicle use, involving, however, most probably a significantly smaller *external* accident cost share.
- The challenge of ratemaking is to *reduce the adverse incentives* inherent in auto insurance.

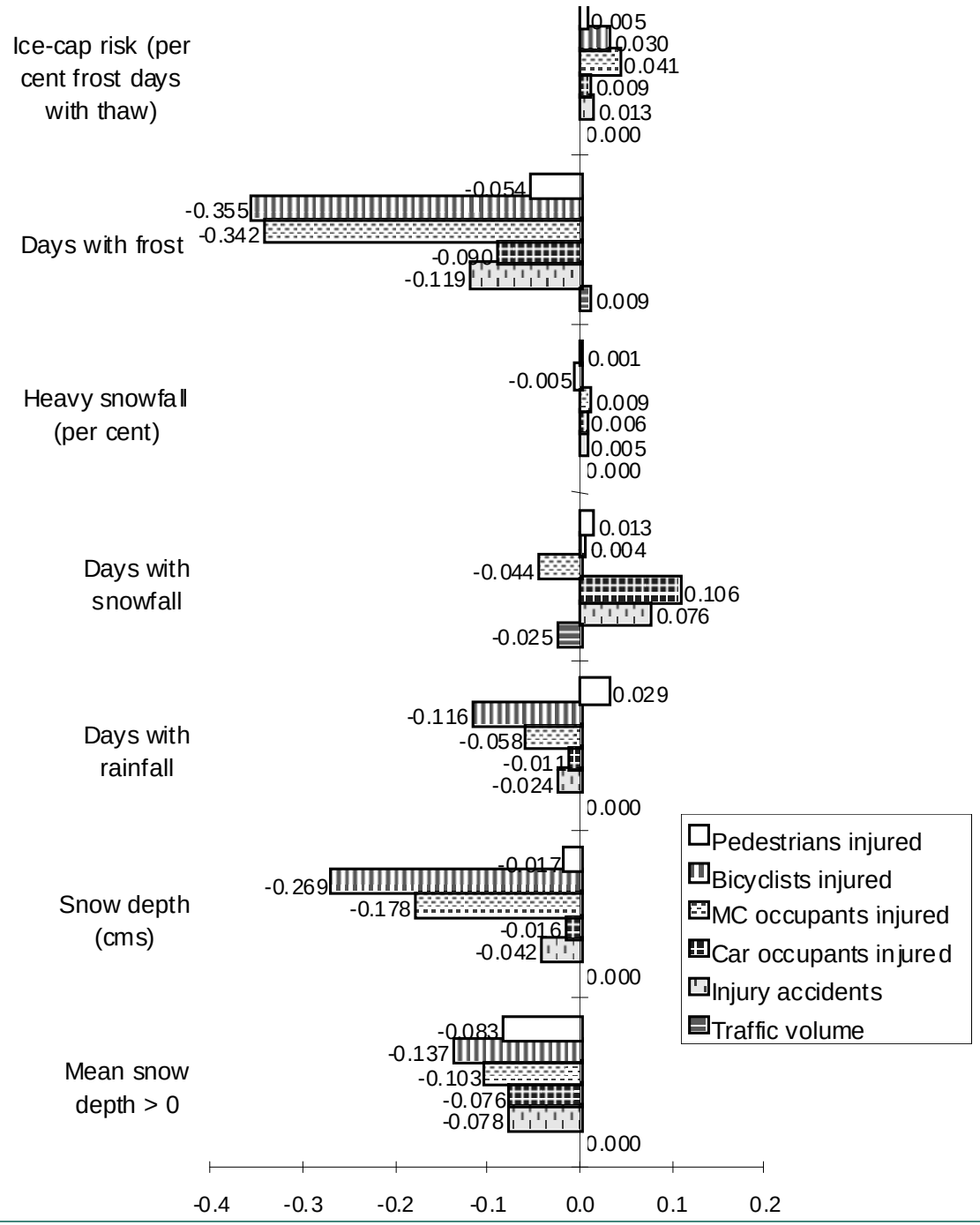
Qualifications

- Econometric work is hardly representative of today's European congestion levels.
- Constrained model has been used in order to elicit strong results; may be subject to specification error.
- Little is known on how the mean accident cost depends on traffic density/congestion. The elasticity is likely to be negative.
- Little is also known on the perceived, internal share of accident costs. We have generally assumed that it does not depend on traffic density.

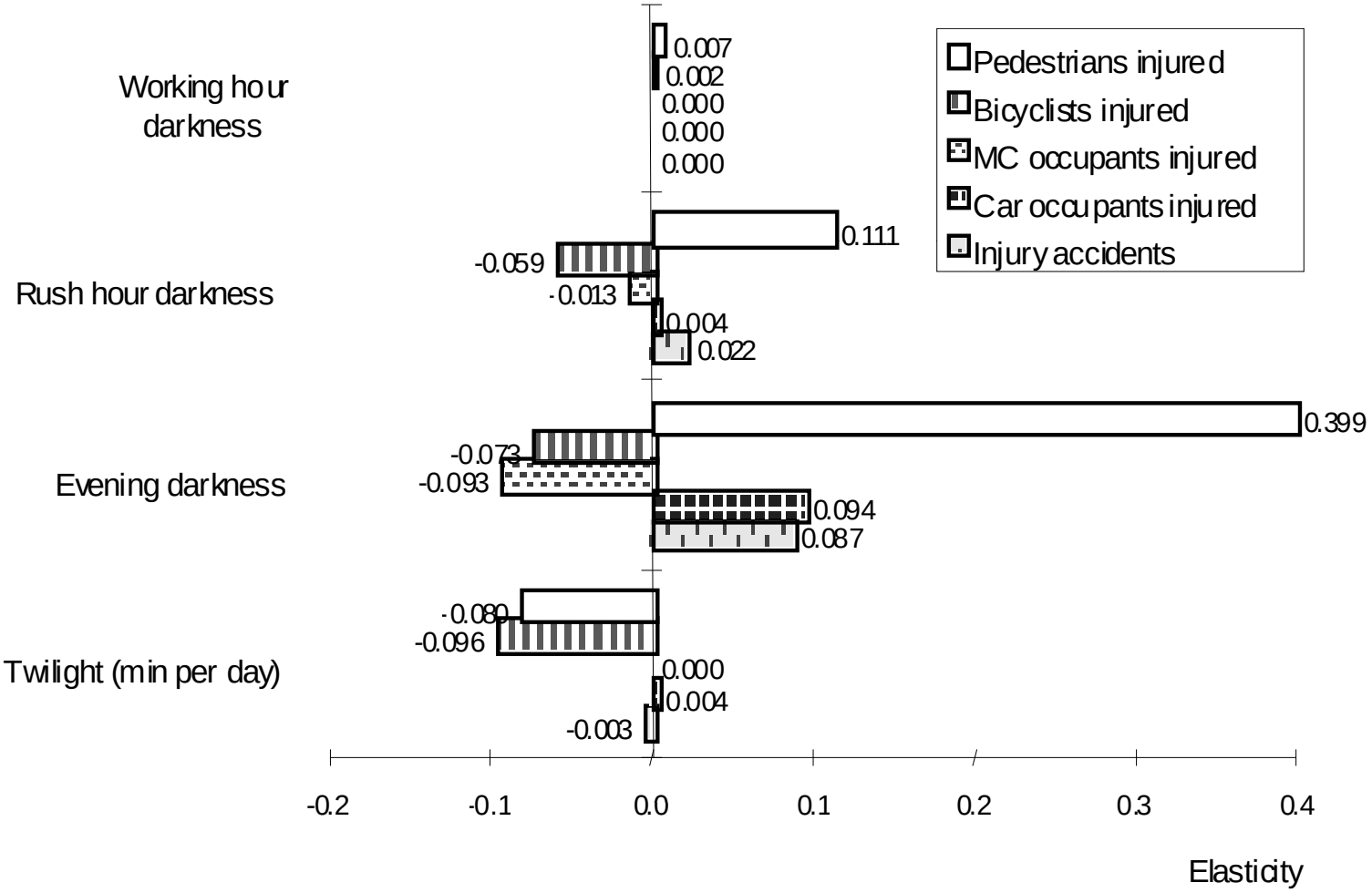
Merci pour votre attention!

Thanks for listening!

Weather effects. Injury accidents and victims by road user category. Norway 1994.



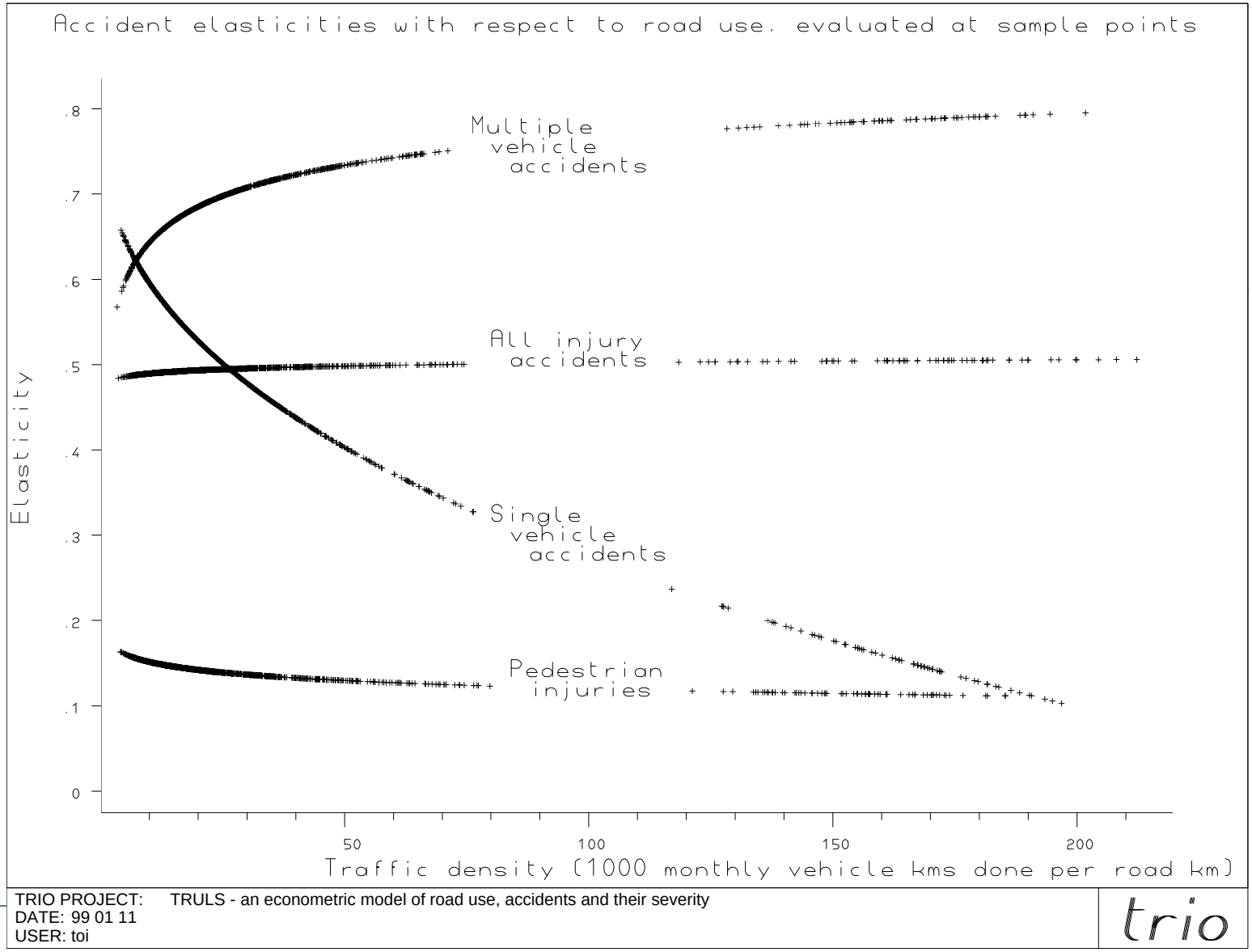
Direct daylight effects, conditional on motor vehicle road use. Injury accidents and victims by road user category. Norway 1994



Partial results from injury accident regression models. Parameter estimates, with t-statistics in parentheses.

Independent variable	Para-meter	Dependent variable: Injury accidents in total	Pedestrian injuries	Single vehicle injury accidents	Multiple vehicle injury accidents
Overall traffic volume (vehicle kilometres)	β_1	0.911 (28.26)	1.109 (14.07)	0.804 (15.95)	1.032 (24.71)
Heavy vehicle share of traffic volume	β_2	0.149 (2.65)	0.105 (0.80)	-0.209 (-2.18)	0.347 (4.61)
Traffic density (vehicle kms per road km)	β_3	-0.435 (-11.02)	-0.927 (-10.66)	-0.081 (-5.30)	-0.569 (-6.88)
	λ_3	-0.013 (-0.17)	0.014 (0.22)	0.408 (2.40)	-0.165 (-1.11)
MC exposure proxy	β_4	0.027 (4.80)	0.036 (3.29)	0.032 (3.14)	0.028 (3.47)
Public bus service density	β_5	0.243 (8.02)	0.764 (10.86)	0.307 (6.50)	0.108 (2.66)
Light rail service density	β_6	0.019 (3.05)	0.065 (5.47)	-0.018 (-1.89)	0.025 (3.39)

Accident elasticities with respect traffic volume, evaluated at sample points and plotted against traffic density.



Unresolved puzzles

- Are we at the stage where the accident externality cost generated by the marginal road user is zero or perhaps even negative, on account of the marginal road user's contribution to congestion and hence to speed limitation?
- Or are we, perhaps, in some heavily congested regions even at a stage where the *total marginal accident cost* (external *and* internal) of road use is approaching zero?
- Is this (one of) the reason(s) why accident counts in Western Europe generally have kept falling since the early 1970s, in spite of increasing road use?
- Is there, perhaps, some kind of trade-off between congestion and accident externalities, the sum of the two being less variable than either, since congestion tends to reduce accidents and/or their severity?