Macroeconomic Effects of Mandatory Bicycle Helmets

A cost-benefit analysis on the Austrian situation, including safety, health and environmental aspects

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INTRODUCTION

Cyclists´ head injury costs versus health benefits

Two contrary lines of arguments characterise research on bicycle helmets:

(1) Helmets safe lives and can reduce head injury costs significantly.

(2) Mandatory helmet wearing deters people from cycling, as a consequence it reduces the health benefits resulting from cycling.

Rising bicycle helmet wearing rates due to legal obligations reduce the risk of head injuries in bicycle accidents. However, international examples show that the obligation to wear a helmet also causes a reduction in kilometres cycled. This reduces the health benefits from cycling. Some cyclists substitute bicycle trips with walking and motorised trips, causing different accident risks. Motorised trips also induce environmental costs. Lower numbers of cyclists increase the specific accident risk for the remaining cyclists as cycling is getting safer the more cyclists ride their bikes (safety-in-numbers effect).

Countries with high bicycle use do not have obligations to wear a helmet …

OBJECTIVES

- To assess the possible effects a legal obligation to wear a helmet would induce in Austria. To give recommendations accordingly.

METHODS

- Extensive literature research on beneficial effects of bicycle helmets and (economic) effects of obligation to wear bicycle helmets
- Modelling a cost-benefit analysis (CBA) for Austria based on available data regarding cycling and accidents
- Calculation of different scenarios
- Conclusions and recommendations

DEFINITIONS / VARIABLES

O	… rate of head injuries without helmet
O´	… rate of head injuries with helmet
OR	… proportion of head injuries with/without helmet
p	… decrease of cycled kilometres [%]
λ	… accident rates [injured cyclists per 10^6 km]

a	… cyclists with head injuries (helmet)
b	… cyclists without head injuries (helmet)
c	… cyclists with head injuries (no helmet)
d	… cyclists without head injuries (no helmet)

$$OR = \frac{O'}{O} = \frac{a\,x\,d}{b\,x\,c} \qquad O = \frac{c}{d} \qquad O' = \frac{a}{b}$$

COST-BENEFIT ANALYSIS (CBA)

In nine scenarios the total of benefits and costs was calculated. How big can the decrease in cycled kilometres become so that macroeconomic costs exceed the benefits? The scenarios (1 – 9) vary the assumed protective effects of the helmets (odds ratio - OR) and the bicycle helmet wearing rates (%) induced by an obligation to wear a helmet.

Benefits

- Reduction of head injury costs due to wearing helmets.
- Reduction in accident costs caused by mode shifts towards motorised modes and walking
- Health benefits due to more walking

Costs

- Lost health benefits due to less cycled kilometres
- Additional accident costs caused by mode shifts towards motorised modes and walking
- Environmental costs from increased motorised mileage
- Additional accident costs because of more injured cyclists (safety in numbers effect)

SCENARIOS

The scenarios chosen (Sc 1 to Sc 9) differ in the assumed helmet wearing rates (%) after making helmets mandatory and the protective capacity of the helmets. The protection was defined as the odds-ratio (OR), of how much more likely it is for cyclists who are not wearing a helmet to suffer head injuries when involved in an accident. Values <1 are interpreted as protective; the smaller the value OR, the bigger the protection. We distinguished between injuries (OR) and fatalities (OR_f).

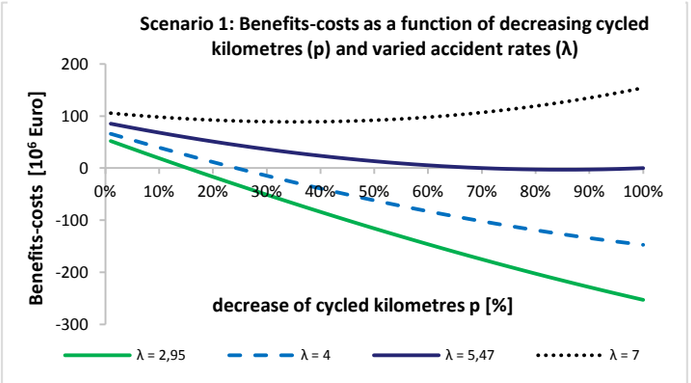
protective effect of helmets (OR): Low / medium / high

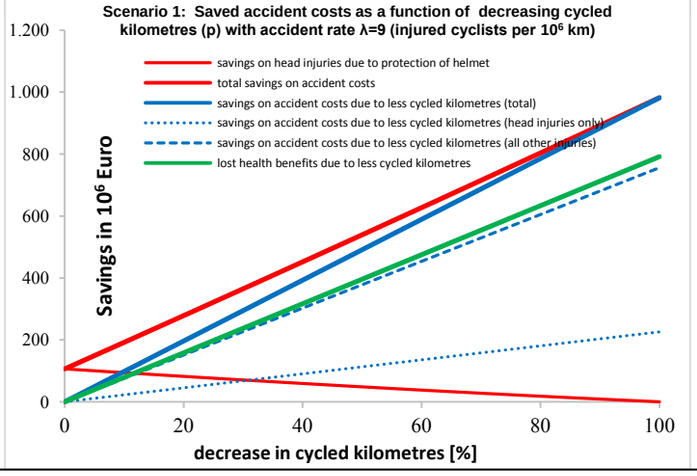
	high	medium	low
		Helmet wearing rate	(mandatory)
high	Sc 1	Sc 2	Sc 3
medium	Sc 4	Sc 5	Sc 6
low	Sc 7	Sc 8	Sc 9

Protection	**high**: OR=0.39; OR_f = 0.15		
Scenario	**Sc 1**	**Sc 2**	**Sc 3**
wearing rate	100%	85%	75%
less cycled km	14.8%	12.8%	11.4%
protection	**medium**: OR=0.5; OR_f = 0.37		
Scenario	**Sc 4**	**Sc 5**	**Sc 6**
wearing rate	100%	85%	75%
less cycled km	11.1%	9.6%	8.5%
protection	**low**: OR=0.65; OR_f = 0.9		
Scenario	**Sc 7**	**Sc 8**	**Sc 9**
wearing rate	100%	85%	75%
less cycled km	5.9%	5.1%	4.5%

RESULTS

The CBA results in estimations of the decrease of cycled kilometres when the mandatory helmet wearing starts causing an economic loss. We calculated the percentage of less cycled kilometres of those cyclists formerly refusing to wear helmets (p) and extrapolated (P) to the decreased mileage of all cyclists.





ACCIDENT RATES (λ) [injured cyclists per 10^6 km]

Accidents with cyclists involved are distinctly underreported, even though this might not be true for severe accidents (fatalities). The actual accident rates might be higher than the reported average of λ = 2.95. The higher λ is, the bigger can the reduction in cycled kilometres get, before the obligation to wear a helmet has negative economic effects. For λ=5.5 or higher, mandatory helmets always have positive effects under the chosen circumstances.

SAFETY OF CYCLISTS - CONCLUSIONS

For high accident rates, savings in accident costs are always bigger than lost health benefits. The proportion of savings caused by the protection of helmets also decreases with decreasing cycled kilometres. The biggest savings (under the given data-quality!) could be found, if bicycling was totally abolished. Interestingly, savings result to a higher extent from “other injuries”, not so much from head injuries. We expect these findings to instigate a debate on cycling safety in general – not only addressing head injuries.

RECOMMENDATIONS

A legal obligation to wear a helmet when cycling (already mandatory for children up to 12 years of age) in Austria could mainly have a negative impact, so we would not recommend it. Data quality was a considerable restriction in setting up this CBA. Better data quality would be needed especially in the following fields:

- Kilometres cycled as well as unreported accidents with cyclists (and pedestrians) involved
- Severity of accidents with cyclists involved, especially of head injuries (the protective effect of helmets is unclear, some authors even deny it for high speed impacts)
- Health benefits of cycling (e.g. the HEAT-tool of WHO currently only calculates mortality, morbidity is still not taken into account).