Centre for Transport Studies
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FINDING A BETTER WAY

Accident externality and vehicle mass – evidence from Swedish collision accidents

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1. Introduction

- A larger vehicle mass protects the occupants in the vehicle while on the same time inflicts a higher injury risk on the occupants in the collision partner

- Two effects - a heavier vehicle protect
  - a heavier vehicle increase the probability to be heaviest

- In a no-fault insurance system the driver pays the accident cost of the own vehicle

- An externality drives the vehicle mass upwards in the fleet

- Presents some idea on internalisation

2. Data

- 1999 – 2004 (spring)
- All passenger car accidents (<3000kg)
- Two vehicle collisions
- In each accident we have labelled “the light vehicle” and “the heavy vehicle”
- Injury types
- Unit costs > Not fully continuous

Table II – Descriptive statistics

	Lighter vehicle		Heavier vehicle	
	Mean	N	Mean	N
Age of driver	40.75	3872	41.03	3878
Male driver (yes=1)	0.63	3870	0.67	3880
Number of passenger	1.38	3890	1.40	3890
Young male driver <25 (yes=1)	0.16	3870	0.13	3878
Number of elder passengers (>60)	0.27	3890	0.30	3890
Speed limit (km/h)	65.11	3719	65.11	3719
Age of car	1989.95	3391	1991.60	3159
Kerb weight (kg)	1183.24	3890	1443.45	3890
Total weight (kg)	1554.21	3890	1858.64	3890
Airbag (yes=1)	0.09	3890	0.16	3890
Fatalities	0.02	3890	0.01	3890
Severe injuries	0.18	3890	0.16	3890
Slight injuries	1.09	3890	1.13	3890
Total material cost (SEK)	219 836	3890	190 719	3890
Total accident cost (SEK)	1 425 900	3890	1 080 580	3890

3. Model

Cost in light vehicle

$$TC_0 = \alpha + \beta_0 \text{Mass}_0 + \beta_1 \text{Mass}_1 + \gamma Airbag_0 + \delta No.ofPassengers_0 + \nu \text{SpeedRestriction} + \varepsilon$$

Cost in heavy vehicle

$$TC_1 = \alpha + \beta_0 \text{Mass}_0 + \beta_1 \text{Mass}_1 + \gamma Airbag_1 + \delta No.ofPassengers_1 + \nu \text{SpeedRestriction} + \varepsilon$$

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4. Results

Table III – Results – weight of both vehicles

	Total Cost in Lighter Vehicle	Total Cost in Heavier Vehicle	Total Cost in Lighter Vehicle	Total Cost in Heavier Vehicle
Constant	-2 534 222 (849 477)	-1 555 290 (503 152)	-2 583 845 (890 386)	-1 372 871 (480 969)
Kerb Weight$_{lighter}$	-1 209 (426)	*147* *(277)*	-1 217 (447)	*-20* *(266)*
Kerb Weight$_{heavier}$	1 130 (498)	*8* *(306)*	1 115 (505)	*161* *(305)*
No. of Passengers	1 101 458 (263 275)	602 300 (137 964)	------	-----
Airbag	-385 628 (153 615)	-349 309 (94 886)	-313 747 (152 933)	-330 389 (95 596)
Speed Restriction	35 035 (5 563)	25 675 (3 567)	34 006 (5 761)	24 115 (3 316)
Male driver 18-25$_{lighter}$	----	------	*374 795* *(594 751)*	*21 177* *(116 905)*
Male driver 18-25$_{heavier}$	----	------	*467 956* *(273 470)*	*-682 210* *(532 090)*
Sex and Age var.	NO	NO	YES	YES
R^2	0.0562	0.0445	0.0678	0.0580
Number of obs.	3719	3719	3692	3692

Robust standard errors in parentheses; Results non-significant at the 5 % -level in italics

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5. The expected external accident cost

- The model

+ Increased probability to be the heavier vehicle with increased mass

Figure 1 – Distribution of kerb weight for passenger cars involved in collision accidents, Sweden 1999-2004

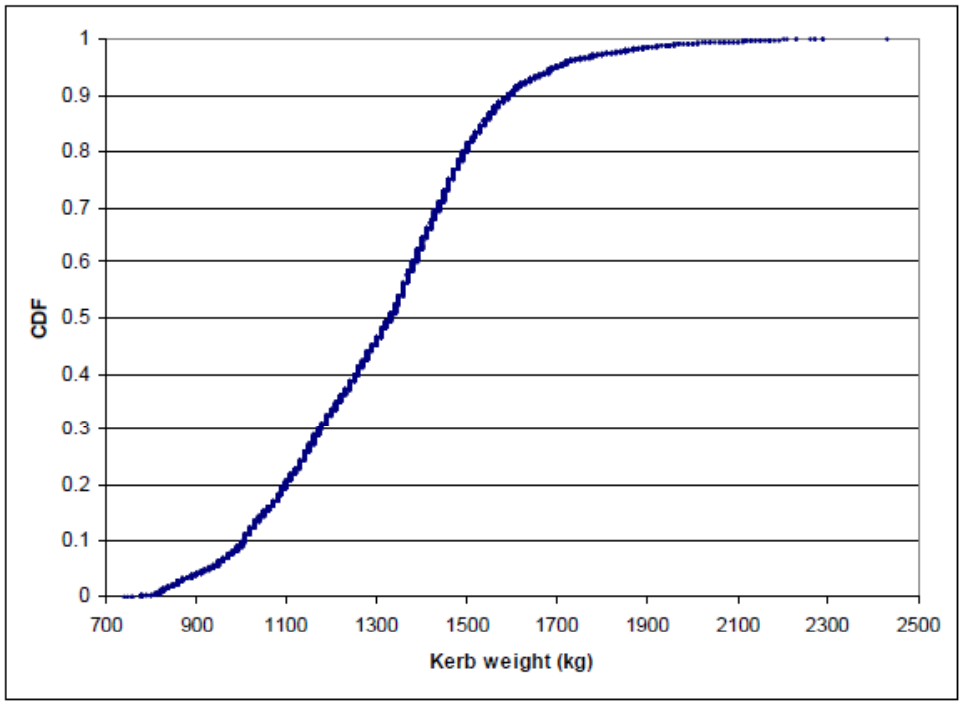


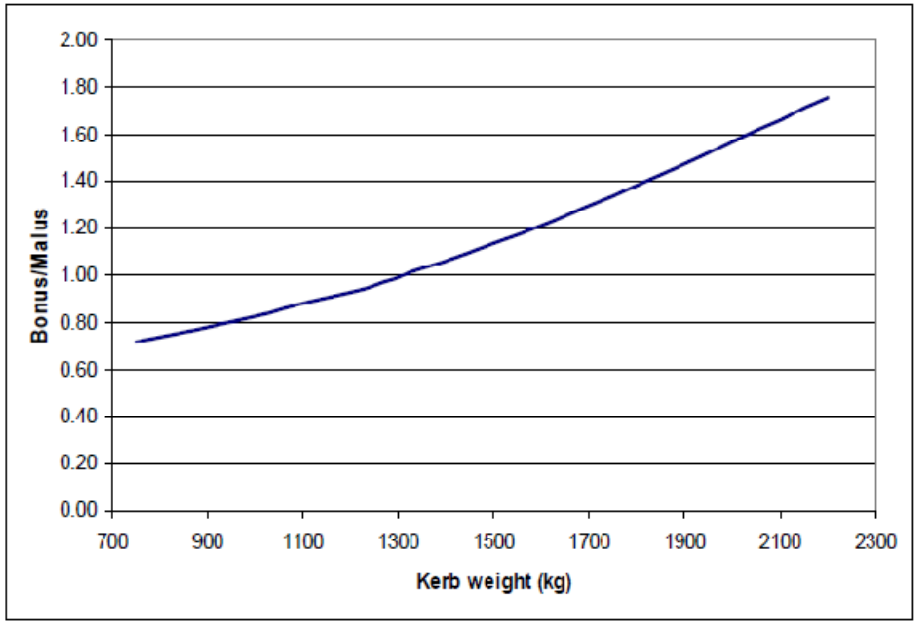
Table V – External and internal expected accident cost

Kerb Weight Vehicle i	Kerb weight j if $z_i > z_j$	Kerb weight j if $z_i < z_j$	CDF $P(z_i < z_j)$	TC_external MSEK	TC_internal MSEK	TC MSEK	External/TC
750	740	1313	0.0003	1.030	1.819	2.850	0.36
1000	829	1335	0.093	1.095	1.494	2.590	0.42
1250	1078	1466	0.394	1.202	1.266	2.468	0.49
1310	1115	1498	0.482	1.239	1.222	2.461	0.50
1500	1233	1649	0.808	1.387	1.139	2.527	0.55
1750	1292	1913	0.965	1.641	1.120	2.761	0.59
2000	1307	2127	0.992	1.916	1.119	3.035	0.63
2200	1312	2277	0.999	2.140	1.120	3.261	0.66

6. Tax to internalise externality

- Insurance premium = own (material) accident cost
- Tax to internalise external accident cost
- Huge – on average 700%
- Given that we internalise this average – we have the following bonus/malus for different vehicle weights

Figure 2 – Bonus/Malus on the average theoretical insurance premium



Thank you