Trucks and SUVs in the Twin Cities Metropolitan Area: How Dangerous Are They?

by Pinar Karaca-Mandic and Jinhyung Lee

Abstract: *Light or heavy trucks and sport-utility vehicles (SUVs) are increasingly popular, in part because they provide improved protection to their own passengers in an accident. However, when an accident occurs, these vehicles also cause greater injury to passengers of other vehicles, pedestrians, bicyclists, and motorcyclists. Because the costs of these injuries are external costs in no-fault auto-liability systems such as those used in Minnesota, consumers may have inefficiently high incentives to purchase light/heavy trucks and SUVs. This study investigated the extent of injury costs associated with light/heavy trucks and SUVs in the Twin Cities metropolitan area. We estimated the relationship between the type of vehicle in accidents involving one light/heavy truck or SUV and one standard passenger car and the level of vehicle damage caused, the likelihood of hospital admissions resulting from the accident, and the hospital charges for those hospitalized from the accident. The analysis showed that the likelihood of hospital admission was highest for occupants of standard cars and lowest for occupants of light/heavy trucks or SUVs. For accidents involving hospitalization, occupants of standard cars also incurred higher hospitalization charges on average compared with occupants of light/heavy trucks or SUVs. These findings suggest that light/heavy trucks and SUVs benefit their occupants in terms of the likelihood of a hospital admission and hospital charges stemming from an accident, but do so at the expense of standard-car occupants. We suggest several policy changes that would internalize the costs that light/heavy trucks and SUVs impose on occupants of other vehicles and pedestrians, and would lead to a more optimal mix of vehicle types in the nation's vehicle fleet.* *The research upon which this article is based was supported by a grant from CURA's Faculty Interactive Research Program.*

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Motor-vehicle accidents are the leading cause of injury-related death for all age groups in Minnesota and the nation. According to the Minnesota Department of Health's Injury and Violence Prevention Unit, 50% of serious traumatic brain injuries and 60% of spinal cord injuries in Minnesota result from a motor-vehicle accident. Among motor-vehicle accident victims, pedestrians, young people (15–24 year olds), the elderly, and male drivers, as well as unbelted passengers and unrestrained children, are at higher risk of injury or death.[1]

Minnesota has a "no-fault" auto-liability system which, in contrast to the more common "tort system," limits a driver's liability for their actions. Evidence is mixed about whether or not no-fault liability systems alter driving behavior and reduce incentives to drive carefully.[2] This concern is particularly important given the change in the composition of motor vehicles on the roads during the last few decades. According to the National Highway Traffic Safety Administration, the proportion of light or heavy trucks and sport-utility vehicles (SUVs) has increased from 22% of motor vehicles on the road in 1980 to 39% in 2000. Research attributes their popularity to the fact that they provide improved protection to

[1] Minnesota Department of Health, Injury and Violence Prevention Unit, *Ten Leading Causes of Nonfatal Hospitalized Injury by Age Group and Gender, Minnesota* (St. Paul: Minnesota Department of Health, 2001), www.health.state.mn.us/injury/pub/ed2001/ed01cause23.pdf.

[2] Several studies found little or no evidence that accidents rates are different in no-fault states—see P.S. Kochanowski and M.V. Young, "Deterrent Aspects of No-Fault Automobile Insurance: Some Empirical Findings," *Journal of Risk and Insurance* 52,2 (1985): 269–288; D.S. Loughran, *The Effect of No-Fault Automobile Insurance on Driver Behavior and Automobile Accidents in the United States* (Santa Monica, CA: RAND Corporation, 2001); R.A. Derrig et al., "The Effect of Population Safety Belt Usage Rates on Motor Vehicle-Related Fatalities," *Accident Analysis and Prevention* 34,1 (2002): 101–110; P. Heaton and E. Helland, "No-Fault Insurance and Automobile Accidents," unpublished paper, April 2010, works.bepress.com/psheaton/7/. Other studies point to empirical evidence that no-fault laws lead to significant increases in traffic fatalities—see E.M. Landes, "Insurance, Liability, and Accidents: A Theoretical and Empirical Investigation of the Effect of No-Fault Accidents," *Journal of Law and Economics* 25,1 (1982): 49–65; R.A. Devlin, "Liability versus No-Fault Automobile Insurance Regimes: An Analysis of the Experience in Quebec," in G. Dionne (ed.), *Contributions to Insurance Economics* (Norwell, MA: Kluwer Academic Publishers, 2010), pp. 499–520; J.D. Cummins et al., "The Incentive Effects of No-Fault Automobile Insurance," *Journal of Law and Economics* 44 (2001): 427–464; and A. Cohen and R. Dehejia, "The Effect of Automobile Insurance and Accident Liability Laws on Traffic Fatalities," *Journal of Law and Economics* 47 (2004): 357–359.

their own passengers.[3] However, it is also generally agreed that when they are involved in an accident, these larger, heavier, and more rigid vehicles cause greater injury to passengers of other vehicles, pedestrians, bicyclists, and motorcyclists.[4] The safety benefits of driving a light/heavy truck or SUV are higher than the cost of damages to pedestrians and the occupants of other vehicles (external costs). In the absence of policy or market interventions that force light/heavy truck or SUV owners to bear the full costs they impose on others, consumers may have inefficiently high incentives to purchase and drive these heavy vehicles.

Previous studies have focused on the external costs of larger vehicles in terms of fatalities, but have not considered other external costs, such as the hospital costs associated with injuries to the occupants of other vehicles resulting from accidents involving larger vehicles. In this article, we describe our study of the relationship between the type of vehicle involved in accidents involving one light/heavy truck or SUV and one standard passenger car and the resulting vehicle damage, hospital admissions, and hospital charges. We investigated the extent of injury costs associated with light/heavy trucks and SUVs in the Twin Cities metropolitan area. To do this, we examined motor-vehicle accident data and hospital discharge data from 2004–2005 to assess the hospitalizations and hospital costs of injuries from accidents that involved one of these larger vehicles. We looked only at two-car accidents that involved one standard passenger car and one light/heavy truck or SUV so we could compare the injury costs for the passengers of each type of vehicle.

Data and Methodology

Our research used a unique data set called the Crash Outcome Data Evaluation System (CODES). The CODES data come from the Minnesota Department of Public Safety and provide information on all police-reported accidents, including age, gender, drinking status, driver/passenger status, and seat-belt usage for all persons involved in the accident, as well as detailed information about the accident itself (including location, time, road type, road conditions, and number of vehicles involved). We linked these CODES data with data on hospital charges for the hospitalized accident victims obtained from the Minnesota Hospital Association, the Emergency Medical Services Regulatory Board, and the Minnesota Departments of Health, Public Safety, and Transportation.

For our analysis, we focused on police-reported accidents in the Twin Cities metropolitan area in 2004 and 2005 that involved two vehicles—one standard passenger car and one light/heavy truck or SUV. The light/heavy truck or SUV category includes pickup trucks, sport-utility vehicles, vans, and minivans. We considered three outcome variables: physical damage to the vehicles, hospital admission for vehicle occupants, and the hospital charges for individuals hospitalized as a result of the accident.

Vehicle Damage. We conducted our analysis of the damage to the vehicle at the vehicle level. CODES categorizes data on damage to the vehicle as none, light, moderate, severe, or total. We simplified this metric by characterizing damage to the vehicle using a binary indicator (0 if no damage; 1 if light, moderate, severe, or total damage). Using logistic-regression techniques, we related vehicle damage to whether the vehicle was a standard passenger car or a light/heavy truck or SUV, as well as to characteristics of the driver (age, gender, seat-belt use, physical condition), the vehicle (number of passengers in the vehicle, auto-insurance status of the vehicle), and the accident (weather conditions, road conditions, and time of accident).

Hospital Admissions. We examined hospital admission at the individual level for both drivers and passengers using a binary indicator (0 if no admission, 1 if the individual received care at a hospital). We used logistic regression once again to relate hospital admissions to the predicted damage to the individual's vehicle (estimated from our damage model), to individual characteristics (whether the individual was the driver or passenger, age, gender, physical condition, seat-belt use), and to vehicle and accident characteristics noted above. Our model allowed us to capture the differential effect of vehicle damage on drivers and passengers.

Hospital Charges. We examined hospital charges at the individual level for those who were hospitalized as a result of their accident. We considered all hospital charges incurred from emergency-room care to the time the patient was discharged to their home, transitional care, or rehabilitation. If the patient was discharged but readmitted within two days, we also considered charges associated with the readmission. We took into account the same individual, vehicle, and accident characteristics noted above for our other analyses. In addition, we considered the payer source for the hospital admission: private insurance, commercial insurance, government insurance (Medicare/Medicaid/MinnesotaCare), or self-payment.

This framework allowed us to first identify the effect of the vehicle type (i.e., standard passenger car versus light/heavy truck or SUV) on the damage to the vehicles in a two-vehicle accident. We then related predicted vehicle damage to the likelihood of hospital admission, and to the hospital charges for those admitted to the hospital. Because our models allowed for predicting the effect of vehicle damage on hospital admission and charges differentially for vehicle drivers and passengers, we could separately predict expected hospital charges for drivers and passengers of standard passenger cars and of light/heavy trucks and SUVs.

Findings

In 2004 and 2005, 10,512 two-vehicle accidents in the Twin Cities metropolitan area involved one standard passenger car and one light/heavy truck or SUV. These accidents involved 29,987 occupants (drivers and passengers) (Table 1). Approximately 96% of vehicles suffered damage (light to total damage), and 8% of occupants were admitted to the hospital. For each occupant, the mean hospital charges for those admitted were $3,625. On average, accidents involved two occupants per vehicle. Roughly 58% of occupants were male. Almost 10% were children or adolescents/teens, 65% were ages

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[3] J.R. Meyer and J.A. Gomez-Ibanez, *Autos, Transit and Cities (*Cambridge, MA: Harvard University Press, 1981); D. Coate and J. VanderHoff, "The Truth about Light Trucks," *Regulation* (Spring 2001): 22–27; and M. White, "The Arms Race on American Roads: The Effect of Sport Utility Vehicles and Pick-up Trucks on Traffic Safety," *Journal of Law & Economics* 47,2 (2004): 333–356.

[4] Meyer and Gomez-Ibanez (1981) found that occupants of small passenger cars are 42% more likely to be seriously injured in an accident with a larger vehicle such as a light truck or SUV. Similarly, Wenzel and Ross (2005) found that SUVs and pickup trucks impose greater driver fatalities on passengers of other vehicles, and that the fatality risks increase with the size of the larger vehicle (T.P Wenzel and M. Ross, "The Effects of Vehicle Model and Driver Behavior on Risk," *Accident Analysis and Prevention* 37 [2005]: 479–494).

19–45, 21% were ages 46–64, and 4% were age 65 or older. Nearly all (97%) of the vehicles had auto insurance. Among occupants who were admitted to the hospital, 4% had private insurance, one-fifth (21%) had government insurance, nearly half (45%) had commercial insurance, and 4% were self-insured.

Nearly two-thirds (60%) of accidents occurred during clear weather, and nearly three-fourths occurred during daylight hours (73%) and under dry road conditions (71%). The physical condition (e.g., under the influence, fatigued, having a physical disability) of half of vehicle occupants was unknown; only 1.1% of occupants (includes both drivers and passengers) were determined to be under the influence of alcohol or drugs at the time of the accident. Seat-belt usage was not reported for 42% of vehicle occupants, but more than half (56%) of occupants did use their seat belt properly.

We analyzed the CODES data for three outcomes: damage to the vehicle (specification 1); likelihood of hospital admission (specification 2); and hospital charges for those admitted (specification 3) (Table 2). The likelihood of damage to the vehicle was significantly lower if the vehicle was a light/heavy truck or SUV. In an accident between a standard passenger car and a light/heavy truck or SUV, the adjusted probability of any damage to the passenger car was 98.7%, whereas it was 94.2% for the light/heavy truck or SUV (Table 2a). Male drivers and drivers 46–64 years of age were less likely to have damage to their vehicles, relative to teenage drivers under 18 who were used as the reference point. Accidents that occurred at sunset or after dark were more likely to result in damage to vehicles.

Damage to the vehicle was, in turn, positively associated with the probability of a hospital admission. The adjusted probability of hospital admission was close to 0% for individuals in vehicles with no damage, compared with 10% for those in vehicles with any damage (light to total damage) (Table 2b). On average, the adjusted probability of hospital admission was 9.5% for a passenger in a standard car, 6.9% for a passenger in a light/heavy truck or SUV, 6.5% for a driver of a standard car, and 3.9% for a driver of a light/heavy truck or SUV (Table 2c). Other factors that were associated with a greater likelihood of hospital admission included female gender, older age, being under the influence of alcohol or drugs, and

Table 1. Descriptive Statistics of Outcome and Explanatory Variables (10,512 two-vehicle accidents, 21,024 vehicles, 29,987 occupants)

Variable (Unit of Analysis)	
Damage to Vehicle (vehicle)	**96.4%**
Hospital Admission (occupant)	8.0%
Total Hospital Charges Conditional on Admission (occupant)	**$3,625**
Number of occupants in the vehicle (vehicle)	1.993
Auto Insurance (vehicle)	**97.4%**
Male (occupant)	57.9%
Age (occupant)	
0–18	9.5%
19–45	64.7%
46–64	21.3%
65 over	4.4%
Payer Source (occupant admitted to hospital)	
Private	4.1%
Government	20.8%
Commercial	45.3%
Self	29.8%
unknown	1.8%
Weather (accident)	
Clear	59.5%
Cloudy	26.7%
Rain	7.1%
Snow	4.3%
Other	2.5%
Unknown	1.3%
Time (accident)	
Light	73.0%
Sunrise	0.9%
Sunset	2.5%
Dark	22.3%
Other	0.1%
Unknown	1.1%
Road Condition (accident)	
Dry	71.0%
Wet	19.1%
Snow	5.2%
Ice	2.8%
Other	2.0%
Unknown	1.3%
Physical Condition (occupant)	
Normal	48.7%
Alcohol or Drug	1.1%
Other	0.2%
Unknown	49.9%
Seat Belt Usage (occupant)	
No Belt	1.3%
Proper Seat-Belt Use	56.1%
Improper Seat-Belt Use	0.3%
Unknown	42.3%

Note: "Other" categories include:

- **Weather:** sleet/hail/freezing rain, fog/smog/smoke, blowing sand/snow, and other
- **Road Condition:** water, muddy, debris, oily, and other
- **Physical condition:** fatigue/asleep, physical disability, ill, and other

accident time being at sunrise (relative to daylight). Not surprisingly, occupants properly using a seat belt were less likely to be hospitalized.

We did not find evidence that damage to the vehicle was associated with hospital charges for those admitted to the hospital.[5] As one might expect, older vehicle occupants had higher hospital charges. Self-paying individuals had lower charges compared with those with private-insurance payers. For those admitted to the hospital, adjusted hospital charges were $3,252 for a driver of a standard car, $3,093 for a driver of a light/heavy truck or SUV, $1,884 for a passenger in a standard car, and $1,156 for a passenger in a light/heavy truck or SUV (Table 2c).

Finally, we calculated the average hospital charges spread across all occupants by vehicle and occupant type (driver or passenger). We found that these charges were $179 for a passenger of a standard car; $80 for a passenger of a light/heavy truck or SUV; $211 for a driver of a standard car; and $121 for a driver of a light/heavy truck or SUV (Table 2c).

Table 2: Models of Damages, Hospital Admissions, and Hospital Charges

(a) Adjusted Probability of Any Damage across Vehicle Type

	Probability
Standard passenger car	98.7%
Light/Heavy Truck or SUV	94.2%

(b) Adjusted Probability of Hospital Admission across Damage

	Probability
No damage	0.0%
Any damage	10.2%

(c) Adjusted Probability and Adjusted Hospital Admission Charges across Vehicle and Occupant Type

Occupant and Vehicle Type	Probability of Hospital Admission	Average Charge for Admitted Occupants	Average Charge for All Occupants
Car Driver	6.5%	$3,252	$211
Car Passenger	9.5%	$1,884	$179
Light/Heavy Truck or SUV Driver	3.9%	$3,093	$121
Light/Heavy Truck or SUV Passenger	6.9%	$1,156	$ 80

Conclusion

Based on our analysis of two-vehicle accidents in the Twin Cities metropolitan area in 2004 and 2005 that involved a standard passenger car and a light/heavy truck or SUV, the probability of hospital admission was highest (9.5%) for passengers of a standard car and lowest (3.9%) for drivers of a light/heavy truck or SUV. For accidents involving hospitalization, occupants of standard cars also incurred higher costs on average (for drivers, $3,252 for a standard car versus $3,093 for a light/heavy truck or SUV; for passengers, $1,884 for a standard car versus $1,156 for a light/heavy truck or SUV). Furthermore, based on our predictions about the probability of hospital admission and our estimates of hospital charges in cases of admission, we found that in a two-vehicle accident between a standard passenger car and a light/heavy truck or SUV, hospital charges to standard-car occupants ($211 for driver, $179 for passenger) were substantially higher than corresponding charges for light/heavy truck or SUV occupants ($121 for driver, $80 for passenger). These findings suggest that light/heavy trucks and SUVs benefit their occupants in terms of the likelihood of a hospital admission and hospital charges from an accident, but do so at the expense of standard-car occupants.

Although we did not analyze fatality of occupants as an outcome, other research provides substantial evidence that the probability of fatality is higher among standard-car occupants than it is among occupants of light/heavy trucks or SUVs.[6] Similarly, we did not consider the cost implications of accidents involving light/heavy trucks or SUVs and pedestrians, bicyclists, or motorcyclists. However, other research has shown these costs to be substantial.[7]

Based on our analysis, the existing tort and no-fault liability systems— and auto-insurance rates in general—likely fail to make light/heavy trucks and SUVs fully accountable for the external costs they impose on other vehicles, pedestrians, and other road occupants. Auto insurance rates for larger vehicles may be higher (approximately 10% to 20%)[8] than for standard passenger cars, but not all of the difference in insurance rates is necessarily attributable to the additional damage or injury they cause to others; much of the difference reflects their increased risk for roll-over

[5] The effect of predicted damage has already been observed in the hospital admission. Thus, the amount of vehicle damage may not have any subsequent effect on hospital charge.

[6] T.P Wenzel and M. Ross, "The Effects of Vehicle Model and Driver Behavior on Risk," *Accident Analysis and Prevention* 37 (2005): 479–494; M. White, "The Arms Race on American Roads: The Effect of Sport Utility Vehicles and Pick-up Trucks on Traffic Safety," *Journal of Law & Economics* 47,2 (2004): 333–356; M. Anderson, "Safety for Whom? The Effects of Light Trucks on Traffic Fatalities," *Journal of Health Economics* 27,4 (2008): 973–989.

[7] M. Anderson and M. Auffhammer, "Pounds That Kill: The External Costs of Vehicle Weight," NBER Working Paper No. 1717, 2011;. S. Li, Traffic Safety and Vehicle Choice: Quantifying the Effects of the 'Arms Race' on American Roads," *Journal of Applied Econometrics* 26 (2001): NA.

[8] Autos.com, "Differences Between Insuring a Car vs. an SUV or Truck," 2010, www.autos.com/auto-insurance /differences-between-insuring-a-car-vs-an-suv-or-truck.

accidents, higher repair costs, and higher theft rates. This is especially the case in a no-fault state that limits the liability of drivers for damage or injury to others. This market failure could lead to an inefficiently larger share of light/heavy trucks and SUVs on our roads and highways simply because the safety benefits of driving a light/heavy truck or SUV are higher than the cost of damages and injuries to occupants of other vehicles and pedestrians (external costs).

Several policies might help to internalize the costs that light/heavy trucks and SUVs impose on other vehicle occupants and pedestrians. For example, corrective taxes could be imposed in the form of an excise tax on heavier vehicles. In Minnesota, the registration tax for passenger-class vehicles such cars, vans, SUVs, and pickups is determined by the base value and age of the vehicle, not vehicle type. Alternatively, gasoline taxes could be increased to ensure light/heavy trucks and SUVs pay an optimal amount of gasoline taxes. Although gasoline taxes do not vary by vehicle type, light/heavy trucks and SUVs consume more gasoline, and thus would be subject to higher taxes. Another alternative is a gasoline tax that is proportional to a vehicle's weight, or one that varies by a vehicle's make and model. However, the enforcement of such a tax would be problematic. Finally, policy makers could consider imposing more stringent safety regulations and licensing requirements on heavier vehicles to reduce accident risks associated with them.

Evaluating the optimal amount of corrective taxes or other corrective policies to internalize the costs that light/heavy trucks and SUVs impose on society is beyond the scope of this article, but such calculations would require quantifying the cost implications of light/heavy trucks and SUVs not only on standard passenger car occupants, but also on other types of vehicle occupants, pedestrians, bicyclists, and motorcyclists. Moreover, a broad range of external-cost implications other than hospitalization costs should be included in this calculus. For example, other monetary and nonmonetary costs of injury, pain and suffering, disability, and fatality need to be considered. In future work, we aim to study and quantify the implications of fatalities in accidents involving light/heavy trucks and SUVs statewide in Minnesota, differentiating between urban and rural settings.

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Chunying Xie Awarded CURA Dissertation Research Grant

Chunying Xie, a doctoral student in the Department of Economics in the College of Liberal Arts at the University of Minnesota, was awarded the 2012 CURA Dissertation Research Grant. The grant provides one year of support to a Ph.D. candidate in good academic standing at the University of Minnesota for the purpose of completing dissertation research on a significant issue or topic related to urban areas in the upper Midwest region.

Xie's research focuses on the MnPASS program's dynamic pricing mechanism. Minnesota has been a pioneer in introducing dynamic pricing into its highway network, beginning with the introduction of the MnPASS program on Interstate 394 in 2005. Motorists who wish to use the special-access MnPASS lanes are charged a variable price that changes every three minutes based on current traffic conditions. If traffic is light, access to MnPASS lanes may cost only $1.25; during heavily congested rush hours, the price could rise to $8.00. This variable pricing mechanism serves an important economic allocation function, ensuring that the price is not so high that it discourages use of the MnPASS lanes, resulting in underutilization, and not so low that it encourages too many vehicles to use the lanes, resulting in congestion that slows buses and carpools.

Xie's research will model how individuals respond "on the fly" to variable prices for MnPASS lanes using a newly available dataset from the Minnesota Regional Transportation Management Center. The dataset includes data in 30-second intervals on traffic volume, congestion, and speed for every lane, entrance, and exit on Interstate 394, as well as corresponding data on the MnPASS lane prices that drivers would have seen at every instant. The model will allow Xie to evaluate the traffic-efficiency gains of the program for drivers in the MnPASS lanes and regular lanes, and provide recommendations for modifying the pricing formula MnPASS uses to make the program more efficient.

An article summarizing Xie's dissertation research will appear in a future issue of the *CURA Reporter*. For more information about the CURA Dissertation Research Grant program, visit www.cura.umn.edu/Dissertation.