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16. Abstract

This study provides comprehensive, economically sophisticated estimates of the costs of highway crashes involving large trucks and buses by severity. Based on the latest data available, the estimated cost of police-reported crashes involving trucks with a gross weight rating of more than 10,000 pounds averaged $75,637 (in 1999 dollars). The average cost of police-reported crashes involving transit or inter-city buses was $54,455 per crash. These costs represents the present value, computed at a 4% discount rate, of all costs over the victims' expected life span that result from a crash. They include medically related costs, emergency services costs, property damage costs, lost productivity, and the monetized value of the pain, suffering, and quality of life that the family loses because of a death or injury.

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Executive Summary

This study provides comprehensive, economically sophisticated estimates of the costs of highway crashes involving large trucks and buses by severity. Based on the latest data available, the estimated cost of police-reported crashes involving trucks with a gross weight rating of more than 10,000 pounds averaged $75,637 (in 1999 dollars). The average cost of police-reported crashes involving transit or inter-city buses was $54,455 per crash. These costs represents the present value, computed at a 4% discount rate, of all costs over the victims' expected life span that result from a crash. They include medically related costs, emergency services costs, property damage costs, lost productivity, and the monetized value of the pain, suffering, and quality of life that the family loses because of a death or injury. Other notable findings include:

- The cost of crashes in which truck-tractors with two or three trailers were involved was the highest among all crashes – $117,309 per crash.
- Among crashes with all configuration information available, bus-involved crashes had the lowest cost – $54,455 per crash.
- The costs per crash with injuries averaged $217,005 for large truck crashes and $131,214 for bus crashes.
- As expected, fatal crashes cost more than any other crash. The average cost of fatal crashes involving truck-tractors with two or three trailers was the highest among all fatal crashes – $3.54 million per crash.
- The crash costs per 1,000 truck miles are $259 for single unit trucks, $138 for single combination trucks, and $134 for multiple combinations.
- The costs of large truck crashes in 1997 exceeded $24 billion. That total included $8.7 billion in productivity losses, $2.5 billion in resource costs, and quality of life losses valued at $13.1 billion.
- Bus crashes were a much smaller factor than truck crashes, costing less than $1 billion in 1997.
- The cost estimates exclude mental health care costs for crash victims, roadside furniture repair costs, cargo delays, earnings lost by family and friends caring for the injured, and the value of schoolwork lost.

Introduction

Trucks and buses with a gross weight rating of over 10,000 pounds constitute the majority of interstate commercial vehicles. They are the primary focus of Federal Motor Carrier Safety Regulations. Crashes involving such vehicles impose a variety of costs on the vehicle and its driver, other drivers either directly or indirectly involved in the crash, and society as a whole. In addition to costs such as property damage, emergency services, and travel delays, injuries and fatalities impose significant costs. This report provides unit costs of large (medium and heavy) vehicle crashes, stated in 1999 dollars.

Safety analysts use crash cost data for a variety of purposes, from analyzing the effectiveness of a particular roadway enhancement to measuring the impact of seatbelt use. Crash costs are used to compare the relative efficacy of various crash countermeasures, which are expected to have a differential impact on crashes of different severity. These figures are also used to calculate and compare the cost-effectiveness of proposed safety regulations. Efficient allocation of research, enforcement, and analysis resources requires reliable data on crash costs.

Miller, Viner et al. (1991) made a first attempt to estimate truck and bus crash costs. They first computed costs by threat-to-life severity measured by Maximum Abbreviated Injury Score (MAIS; AAAM, 1985). The AIS scheme is a detailed medical classification developed by physicians as a basis for rating the survival threat injuries pose. It assigns a numeric rating ranging from 0 (uninjured) to 6 (maximum, generally unsurvivable). National Highway Traffic Safety Administration (NHTSA) data sets that are AIS coded add codes for “injured, severity unknown” and “unknown if injured”. MAIS is simply the maximum AIS among the multiple injuries a victim suffers. The purpose of the AIS scale is to differentiate injuries by survival threat, not the cost, functional losses, or course of recovery they involve. For example, loss of teeth is an AIS-1 injury that can involve substantial costs and lifetime pain and suffering. Conversely, timely surgery often allows complete and rapid recovery from ruptured spleens and other AIS 3-5 internal injuries. Nevertheless, average costs per case within a body region almost always rise with MAIS (Miller 1993).

By multiplying average costs per highway crash victim by MAIS times the MAIS distribution of victims in crashes sorted by the heaviest vehicle involved, Miller, Viner et al. (1991) estimated costs by vehicle type. Those estimates implicitly assumed that the distribution of injuries by body region within an AIS severity level did not vary with vehicle type. Only property damage and crash-related travel delay costs were tailored to truck and bus crashes.

Miller, Levy et al. (1998) and Miller, Spicer et al. (1999) improved on Miller, Viner et al. (1991) by computing medium/heavy vehicle crash costs by vehicle type from 1982-1992 data on victim MAIS and body region in medium/heavy vehicle crashes. They also tailored the costs by victim age and sex. The present report parallels their methods. It updates their estimates and

substantially increases the number of cases used to estimate the injury distribution for occupants of light passenger vehicles involved in medium/heavy vehicle crashes. With the larger sample, it is able to more finely differentiate costs among heavy vehicle types. Notably, the present study is the first to differentiate costs of single versus multiple trailer crashes. Within the constraints of available data, it provides economically sophisticated, reliable estimates of the average costs of medium/heavy vehicle crashes with different levels of severity.

Methods

Estimating crash costs requires estimates of the number of people and vehicles involved in a crash, the severity of each person's injuries, and the costs of those injuries and associated vehicle damage and travel delay. The following section describes the methodology used to estimate the incidence and severity of large truck and bus crashes. The succeeding section explains how the costs of crashes were estimated.

Incidence and Severity Estimation. To estimate injury incidence and severity, we followed procedures developed by Miller and Blincoe (1994) and Miller, Galbraith et al. (1995) and also applied in Blincoe (1996), Miller, Levy et al. (1998), Miller, Lestina, and Spicer (1998), and Miller, Spicer et al. (1999). Our estimates of the average number of people and vehicles involved in a medium/heavy vehicle crash by vehicle type, restraint use, crash severity, and police-reported injury severity come from NHTSA's Fatal Analysis Reporting System (FARS) and General Estimates System (GES).

Crash databases do not accurately describe the severity of large truck and bus crashes. Accordingly, we made several adjustments to more accurately reflect the severity of crashes. These adjustments are described below.

FARS is a census of U.S. fatal crashes but it does not describe injuries to survivors in these crashes. GES provides a sample of U.S. crashes by police-reported severity for all crash types. GES records injury severity by crash victim on the KABCO scale (National Safety Council, 1990) from police crash reports. Police reports in almost every state use KABCO to classify crash victims as K-killed, A-disabling injury, B-evident injury, C-possible injury, or O-no apparent injury.

KABCO ratings are coarse and inconsistently coded between states and over time. The codes are selected by police officers without medical training, typically without benefit of a hands-on examination. Some victims are transported from the scene before the police officer who completes the crash report even arrives. Miller, Viner et al. (1991) and Blincoe and Faigin (1992) documented the great diversity in KABCO coding across cases. O'Day (1993) more carefully quantified the great variability in use of the A-injury code between states. Viner and Conley (1994) explained the contribution to this variability of differing state definitions of A-injury. Miller, Whiting et al. (1987) found police-reported injury counts by KABCO severity systematically varied between states because of differing state crash reporting thresholds

(the rules governing which crashes should be reported to the police). Miller and Blincoe (1994) found that state reporting thresholds often changed over time.

Thus, police-reporting does not accurately describe injuries medically. To minimize the effects of variability in severity definitions between states, reporting thresholds, and police perception of injury severity, we turned to NHTSA data sets that included both police-reported KABCO and medical descriptions of injury in the Occupant Injury Coding system (OIC; AAAM 1990, AAAM 1985). OIC codes include AIS score and body region, plus more detailed type injury descriptors that changed from the 1985 to the 1990 edition. We used both 1988-91 Crashworthiness Data System (CDS; NHTSA 1995) and 1982-86 National Accident Sampling System (NASS; NHTSA 1987) data. CDS describes injuries to passenger vehicle occupants involved in towaway crashes. The 1982-86 NASS data provide the most recent medical description available of injuries to medium/heavy truck and bus occupants, non-occupants, and other non-CDS crash victims. The NASS data were coded with the 1980 version of AIS, which differs slightly from the 1985 version; but NHTSA made most AIS-85 changes well before their formal adoption. CDS data were coded in AIS-85 through 1992, then in AIS-90. We did not use CDS data after 1991 because AIS scores in AIS-90 differ greatly from scores in AIS-85, especially for brain and severe lower limb injury. Garthe et al. (1996) find that AIS scores shifted for roughly 25% of all OICs between AIS-85 and AIS-90. Because cost estimates by AIS-90 severity do not exist, we did not use CDS data from 1993 onward. We pooled all other available years of data in order to get sufficient cases for analysis by truck type.

We used 1988-1997 GES data to weight the CDS and NASS data so they represent the annual estimated GES injury victim counts in medium/heavy vehicle crashes by CDS and NASS sample strata. In applying these weights we controlled for police-reported injury severity, restraint use, and vehicle occupied (or non-occupant). Weighting the NASS data to GES restraint use levels updates the NASS injury profile to a profile reflecting contemporary belt use levels. Again, sample size considerations drove the decision to pool all available data. At the completion of the weighting process (Figure 1), we had a hybrid CDS/NASS file with weights that summed to the estimated annual GES incidence by police-reported injury severity and other relevant factors.

Trucks and buses with a gross weight rating of over 10,000 pounds were grouped into the following categories:

1. Straight truck, no trailer;

2. Straight truck with trailer;

3. Straight truck, unknown if with trailer

4. Truck tractor with no trailer (bobtail);

5. Truck tractor with one trailer;

6. Truck tractor with two or three trailers;

7. Truck tractor with unknown number of trailers;

8. Medium/heavy truck, unknown if with trailer;

9. All large trucks; and

10. Transit/inter-city bus

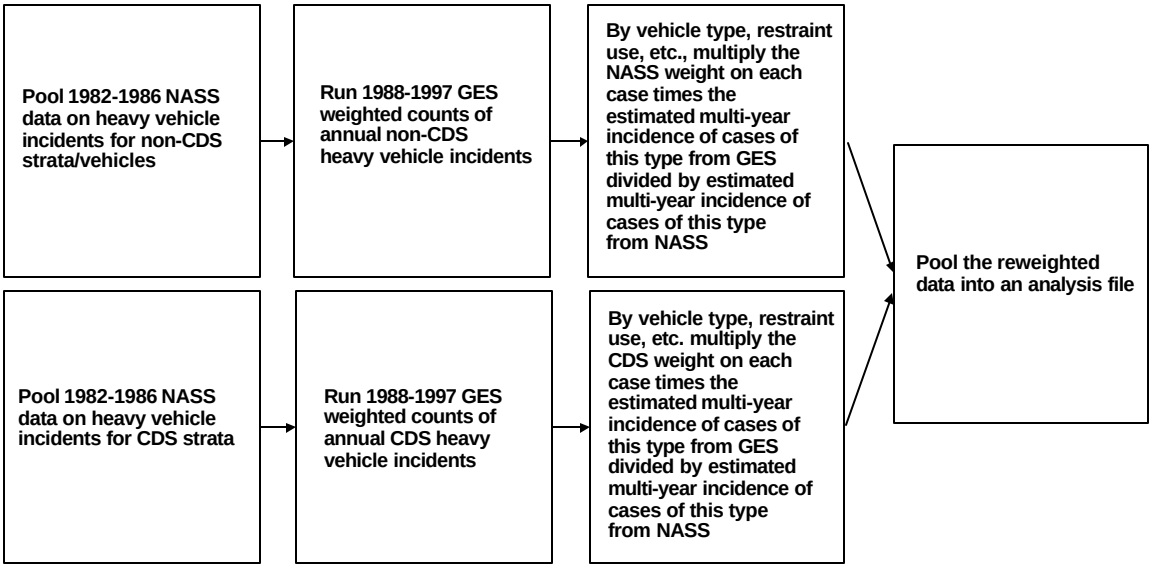

Figure 1. The merger of NASS, CDS, and GES files

In order to create reasonable sample sizes, two assumptions were made in the categorization of trucks/buses. Trucks that were reported in the GES and FARS data as medium/heavy trucks and had no trailing units were assumed to be straight trucks with no trailer. Trucks that were reported as unknown medium/heavy trucks and had more than one trailing unit were assumed to be truck tractors with two or three trailers.

In addition to the grouping based on the above assumptions, straight trucks with trailer and medium/heavy trucks with one trailer were grouped together because of a discrepancy between FARS and GES estimates. A count of fatal truck crashes based on FARS revealed that medium/heavy trucks with one trailer were involved in 131 fatal crashes between 1988 and 1997. The respective GES estimate was 742. On the other hand, FARS data suggested that straight trucks with one trailer were involved in 869 fatal crashes during the same period, as opposed to 176 estimated from GES data. Since FARS data are much more reliable than GES data – FARS represents a census of fatal crashes as opposed to GES, which is simply a modest sample – it was assumed that a good number of straight trucks with trailers were miscoded in the GES files as unknown medium/heavy truck with one trailer. Therefore, in absence of a reliable way of separating out the misrepresented cases, unknown medium/heavy trucks with one trailer were included in the category "straight truck with trailer."

Cost Estimation. The second step required to estimate average crash costs is to generate estimates of crash costs by severity. This section describes the process used to develop these estimates. In order to estimate the average costs per crash by medium/heavy vehicle type and crash severity, costs per injury by MAIS and body region were adapted from the costs in Miller (1997) and Miller, Spicer et al. (1999). These costs were merged onto the GES-weighted NASS/CDS file. The costs represent the present value, computed at a 4% discount rate, of all costs over the victim's expected life span that result from a crash. We included the following major categories of costs:

- Medically related costs
- Emergency services
- Property damage
- Lost productivity
- Monetized Quality-Adjusted Life Years (QALYs)

The present study updated the medical cost estimates from Miller (1997) and adjusted its other cost estimates to comply with official US Department of Transportation injury cost guidance and methods (McCormick and Shane, 1993; Krusei and McFadden, 1996). Notably, to obtain the present value of costs in future years, we re-estimated medical costs of severe brain and spinal cord injuries, productivity losses, and quality of life losses with a 4% discount rate rather than the 2.5% rate used in those studies. A higher (lower) discount rate would lower (raise) future costs, especially those that occur farther into the future.

Medically Related Costs include hospital, physician, rehabilitation, prescription, and related payments. Also included are coroner and burial costs for fatalities, and claims processing costs of medically-related loss compensation through insurance and the courts (omitting time spent on the loss recovery process).

To update medical costs, we computed total medical costs of crashes in 1996, then used this aggregate information to adjust prior detailed cost estimates by MAIS and body region injured. The new estimate of total medical spending on crash victims used methods and data developed in a study of childhood injury costs (Miller, Romano and Spicer 2000) and in building the US Consumer Product Safety Commission's Injury Cost Model (ICM) (Lawrence et al. 1999). These methods are described briefly below, and more thoroughly in the ICM documentation (Miller, Lawrence et al. 1998).

First, we estimated the incidence of injury in motor vehicle crashes on public roads. The estimated number of medically treated victim by diagnosis, age group, and sex for patients not admitted to hospital came from 1996 National Health Interview Survey (NHIS) which explicitly identifies crash victims. For hospital-admitted victims, following Miller, Romano and Spicer, we created a version of the 1996 National Hospital Discharge Survey (NHDS) with injury

causes inferred for the 37% of injury victims with no cause reported in the data set. NHDS provides seven fields for coding injury diagnoses and/or causes. The cause distribution of known cases with five or fewer diagnoses by primary diagnosis, age group, sex, and number of diagnoses (1-2, 3-5) was inferred probabilistically, based on the causes that were reported. For cases with six or seven diagnoses, we inferred the cause distribution using data on discharges with at least six diagnoses from six states with mandatory cause coding and either a separate cause-code field or at least ten diagnosis/cause fields– CA, MD, MO, NY, SC, and VT.

Next, we computed medical costs for each crash victim. Although the methods differed for deaths, injury survivors admitted to the hospital, and injury survivors treated elsewhere, in each case, we extracted costs of initial treatment from nationally representative or multi-state data sets. By diagnosis, we then added emergency medical, medical follow-up, rehabilitation, and long-term costs computed from national data on ancillary costs and the percentage of medical costs associated with initial treatment. Due to data unavailability, the emergency medical, follow-up, rehabilitation and long-term costs were less current than the costs for initial treatment. More specifically, for non-hospitalized victims, medical costs were estimated from:

- Medical care costs per visit by diagnosis from 1992-1994 Civilian Health and Medical Program of the Uniformed Services (CHAMPUS) data,

- Visits per case during an average of six months post-injury and emergency transport, prescription and ancillary payments per case by diagnosis group from 1987 National Medical Expenditure Survey (NMES) data, and

- The percentage of medical costs for non-admitted patients that are incurred more than six months after injury by diagnosis from 1979-1988 Detailed Claims Information (DCI) data of the National Council on Compensation Insurance (Miller, Viner et al. (1991) used the same DCI data, which are unique.)

For admitted patients, medical costs were estimated from

- Actual hospital days per patient from the NHDS file

- Costs per day of hospital stay by diagnosis, age group, and sex estimated from 1994 NY and 1994-1995 MD hospital discharge data, price-adjusted to national estimates, (These two states are the only ones that regulated and tracked the detailed relationships between charges, payments, and actual costs of hospital care in recent years, a practice New York discontinued after 1994. Because health care payers negotiate widely varying, sometimes large discounts from providers, the more widely available data on hospital charges bear little relationship to actual hospital costs.)

- The ratio of professional fees for inpatient care to hospital payments from 1992-1994 CHAMPUS data,

- The average number of hospital admissions per patient by primary injury diagnosis from 1994 MO hospital discharge data (which we used because we were able to obtain a file with linkable patient identifiers),

- Pre-hospital, prescription and ancillary payments per case, as well as short-term post-discharge costs, from 1987 NMES data, and

- The percentage of medical costs for admitted patients that are incurred more than six months after injury by diagnosis from 1979-1988 DCI data.

Medical costs for crash fatalities were computed from US Vital Statistics data on place of treatment. All fatalities were assigned the difference in present value of burial costs in 1996 versus at the end of the victim's expected life span (from Miller, Pindus et al., note x), as well as coroner or medical examiner costs from NHTSA (1983). Except for deaths at the scene, we added costs of emergency transport from 1987 NMES data. For deaths on arrival or in the emergency department, we added average charges for fatalities in the emergency department by external cause grouping from 1997 South Carolina emergency department discharge data, adjusted to US prices. Deaths in hospital were costed using the same methods as other hospital admissions but with no post-discharge costs. We assumed deaths in nursing home were preceded by hospital admissions of average cost and involved a 30-day skilled nursing facility stay at double the cost of an intermediate care facility (from Bureau of the Census 1998).

Unfortunately, within the budget available, the aggregate cost estimate for nonfatal cases could not be broken down by MAIS and body region. Therefore, we adjusted published prior medical cost estimates for 1996 highway crashes (Miller, Lestina, and Spicer, 1998) to account for the difference between our total nonfatal medical cost estimate and the published one, essentially retaining the prior cost patterns by severity. The adjusting factor was 0.924. The difference between our estimate and the previous estimate can be explained by the fact that Miller, Lestina and Spicer (1998) inflated medical cost estimates using the medical spending inflator, whereas our estimate directly reflects the medical spending levels of the managed care era. Obviously, the use of the above adjusting factor does not guarantee that the adjustment of medical cost estimates by severity is as accurate as the adjustment of the medical cost estimate as a whole.

Since the new cost estimates preserve the old pattern of costs by MAIS and body region, it is worth summarizing how those costs were computed. Medical payments for paralyzing (MAIS 4 and 5) spinal cord injury came from a household and institutional survey (Berkowitz et al. 1990). Miller, Viner et al. (1991) and Miller, Pindus, and Douglass (1993) developed the remaining costs from 1979-1988 DCI data. Payments per case were estimated by diagnosis and hospitalization status (admitted or not). Non-hospitalized costs were built from 1982-1986 NASS data on whether treated and DCI costs per treated case. Hospitalized costs combined NASS length of initial hospital stay, DCI hospital per diem payments, readmission costs in the year after injury

from MacKenzie, Shapiro, et al. (1988), and DCI data on longer-term payments. The costs were validated against average costs per injured highway crash survivor by hospitalization status from Rice et al. (1989). The costs were inflated to 1999 dollars using medical spending per capita as an inflator series.

Emergency Services Costs include police, fire, ambulance, and helicopter services. Miller, Viner et al. (1991) computed emergency transport costs from the cost per transport by hospitalization status in Rice et al. (1989) and NASS data on the percentage of cases transported by treatment level, MAIS, and body region. They allocated helicopter transport proportionally across nonfatal MAIS 4 and 5 injureds and fatalities who died in the hospital. The costs per transport came from National Medical Care Utilization and Expenditure Survey data (Rice et al, 1989) and published helicopter medical transport statistics, and are averages for all injury victims who were transported. From a survey of 6 providers, Miller, Viner et al. (1991) estimated 65% of trauma transports were for motor vehicle crashes.

Fire and police costs were computed from assumed response patterns by crash severity and vehicle involvement, constrained by data on total responses. For fatal, injury, and PDO crashes, time spent per police cruiser responding came from ten jurisdictions with automated police time-tracking systems. A single officer was assumed to have responded to a PDO crash and one officer per injury to other crashes. Time spent per fire truck responding came from nine large fire departments. It was assumed that the fire personnel would respond to:

- 90 percent of fatal and severe injury crashes and 95 percent of critical injury crashes.
- 35 percent of serious injury crashes and 15 percent of moderate injury crashes.
- 40 percent of heavy truck crashes involving minor injury and 1 percent of other minor injury crashes.
- 25 percent of police-reported heavy truck crashes involving only property damage.

Property Damage is the cost to repair or replace damaged vehicles, cargo, and other property including the costs of damage compensation. Property damage costs were inflated, using the Consumer Price Index – All Items, from Miller, Viner et al. (1991) for medium/heavy vehicles and from Blincoe (1996) for light vehicles. The original medium/heavy vehicle property damage estimates came from Bureau of Motor Carrier Safety (BMCS) 50-B and 50-T crash reports and represent vehicles in interstate commerce. The BMCS reports were completed by vehicle owners. BMCS did not audit owner estimates of crash damages for accuracy.

Lost Productivity includes wages, fringe benefits, and household work lost by the injured, as well as the costs of processing productivity loss compensation claims. It also includes productivity loss by those stuck in crash-related traffic

jams and by co-workers and supervisors investigating crashes, recruiting and training replacements for disabled workers, and repairing damaged company vehicles. Excluded are earnings lost by family and friends caring for the injured and the value of schoolwork lost. The productivity loss resulting from traffic delay is given separately and as part of total productivity lost.

Miller (1997) updated the lifetime earnings and household production loss models in Miller, Viner et al. (1991) with 1990-1991 data. Loss models estimate likely lifetime productivity based on demographic characteristics, earnings profiles, and life tables. The productivity loss attached to each NASS/CDS victim was age and sex specific. For cost calculations by crash type, tailoring costs for each case by age and sex represents a major improvement over Miller, Viner et al. (1991). Employer productivity losses largely were recomputed using the assumptions in Miller and Galbraith (1995), namely:

- A quarter of the time wasted by deaths, disabling injuries, and injuries outside of work is supervisory time.
- A fatal injury costs 4 months of productivity (wages plus fringe benefits). Recruitment, retraining, and lost special skills are the major cost factors.
- A disabling injury serious enough to qualify for Worker's Compensation or require hospital admission costs one month of productivity for other employees. On average, such injuries involve 41 days of work loss.
- Other injuries outside of work cause 3 days of lost productivity if they involve work loss and 1.5 days otherwise.
- Other injuries on the job that cause work loss cost 2 days of supervisory time and 4 days of non-supervisory time.
- Work-related crashes without lost-work injuries cost 2 days of supervisory time and one day of non-supervisory time. This assumption is consistent with PHH FleetAmerica's unpublished data from their subscribers.
- Other on-duty injuries without work loss cost one supervisory day and one non-supervisory day.

Following Miller, Spicer et al. (1999), however, supervisor and co-worker staff time lost to a permanently disabling injury was assumed to equal the losses for a fatality.

These assumptions yield employer costs that average $13,379 for a fatality, $2,162 for a lost-workday injury, and $405 for an injury without work loss. By comparison, in a Washington state study of construction injury costs, Hinze (1991) finds employer costs of $1,273 for a lost-workday or restricted-activity injury and $462 for an injury without workdays lost. Leigh et al. (1995) estimate employer costs at $8,108 for a fatality, $6,757 for a partial

permanent disability, $676 for a less serious lost-workday injury, and $135 for an injury without work loss*.

Miller (1997) developed the insurance administrative and legal expense models used in the cost computations. It introduced a $100,000 average policy limit on liability daims and a $500,000 limit on average court awards for catastrophic injuries. Legal costs were reestimated with unit litigation costs from Kakalik and Pace (1986) and probabilities of lawsuit from Hensler et al. (1991), as well as the updated medical care and productivity loss estimates used to estimate attorney fees, which average 31 percent of losses recovered (Hensler et al., 1991).

Travel delay was computed similarly to Miller, Viner et al. (1991), but with three refinements. First, the prior work differentiated delay by crash severity in proportion to police time at the crash scene. We modified the prior analysis by assuming that the larger number of emergency vehicles involved in injury and fatal crashes creates twice as much delay per minute on the scene as a crash involving property damage only (PDO). That assumption, which reduced delay costs for PDO crashes, resulted in an hours-of-delay ratio of 40:130:385 for the delays due to PDO, injury, and fatal crashes. Second, we increased the hours of delay per urban interstate crash in proportion to the major increase documented by Lan and Hu (2000) in Minneapolis-St Paul. Their study found an average of 5057 hours of delay per heavy truck crash in Minneapolis-St Paul (and 2405 hours per crash without heavy vehicles involved). The study collected data on 289 heavy truck crashes (and 3,762 other crashes). Third, the previous analysis arbitrarily assumed no travel delay on some classes of roadways and arbitrarily stepped down the delay estimates for other classes. Instead, we started from the hours of delay per crash on urban interstates (the most complete and data-driven estimates available). Delay for other roadway classes by rural-urban location was computed in proportion to traffic density (vehicle-miles per lane mile) for each roadway class relative to urban interstate. Traffic density was computed from Federal statistical data (FHWA 1998). We used the costs per hour of delay from the prior analysis (60 % of the wage rate for non-commercial drivers and 100 % for commercial drivers) since they fell in the range prescribed by current guidance from the Office of the Secretary (U.S. DOT, 1997). Table 1 details the delay estimates per heavy vehicle crash by roadway class and location.

* Costs inflated to 1999 dollars using the wage index.

Table 1. Hours of Delay per Heavy Vehicle Crash by Roadway Class, Location, and Severity

Road Class/Location	PDO	Injury	Fatal
URBAN			
Interstate	2260	7344	21749
Other Freeway	1766	5737	16990
Major Arterial	949	3082	9127
Minor Arterial	594	1929	5711
Collector	31	102	301
Local Street	9	28	83
RURAL			
Interstate	814	2646	7835
Major Arterial	416	1350	3999
Minor Arterial	255	829	2454
Major Collector	10	34	100
Minor Collector	4	14	42
Local Street	1	4	12

Note: Delay on local streets includes vehicles unable to exit from driveways as planned and therefore not in operation. Each hour of delay is valued at $13.86 in urban areas and $16.49 in rural areas. The cost differential is due to the differences in vehicle occupancy.

Monetized Quality-Adjusted Life Years (QALYs) values the pain, suffering, and quality of life that the family looses because of a death or injury. For fatalities, the monetized value of QALY loss ($2.7 million) comes from the Office of the Secretary of Transportation's (OST) guidance (Krusei and McFadden, 1996). It is computed from the amount people routinely spend (in dollars or time) to reduce their risk of death and injury. The value derives from almost 50 studies of explicit or implicit family expenditures on auto safety features, pedestrian safety, and smoke detectors, and of extra wages paid to workers who take risky jobs. The OST value given is for the average highway crash fatality. We used it to compute the present value of QALY loss per fatality by victim age and sex, then applied those values to the age and sex distribution of people killed in medium/heavy vehicle crashes in 1997 from FARS.

For nonfatal injuries, as in the OST's guidance (Krusei and McFadden, 1996), the costs are developed from estimated quality-adjusted life years (QALYs) lost. A QALY is a health outcome measure that assigns a value of 1 to a year of perfect health and 0 to death. Prior studies (Miller 1993; and Miller, Pindus et al., 1995) assessed QALY losses along seven dimensions: cognitive, mobility, bending/grasping/lifting, sensory, cosmetic, pain, and ability to work. With survey data describing how people value losses within and between dimensions, they computed average QALY loss for crash victims by MAIS and body region. To compute the percentage of lifetime QALYs lost over the victim's lifetime, one averages the fraction of perfect health lost (the QALY loss) during each year that a victim is recovering from a health

problem or living with a residual disability (with some adjustments to get a present value estimate). To monetize the loss, we multiplied the percentage loss by the loss per fatality when someone of the victim's age and sex was killed. To avoid double-counting, we subtracted lost productivity from estimated quality of life lost.

The resulting cost estimates were inflated to 1999 dollars using the Employment Cost Index (Economic Report of the President, 2000). Finally, costs per injury were multiplied by the average number of injuries by severity per crash to produce cost estimates per crash, by truck type and crash severity.

Results

Table 2 summarizes estimated victims per highway crash, by truck/bus type and police-reported injury severity. For example, the table indicates that crashes in which trucks with no trailers are involved, an average of 1.993 people had no injury, 0.198 had possible injury, and so on. An average of 2.430 are involved in these types of crashes. Some caution is warranted in interpreting these numbers because police-reported injury severity is often inaccurate. Many victims who the police code as not injured are actually injured; conversely, the majority of injuries reported by police as disabling do not result in hospital admission (Miller et al. 1991). These shortcomings are one of the reasons why Miller, Lestina, and Spicer (1998) developed their injury costs based on the body region injured, MAIS threat-to-life severity, and level of medical treatment.

Another problem with police-reported counts of people in crashes, which is evident in Table 2, is the undercount of uninjured people involved in transit/intercity bus crashes. Specifically, Table 2 suggests that no more than 3 people were involved in an average transit/intercity bus crash. This obviously incorrect number results from the widespread police practice of not recording uninjured bus passengers involved in a crash.

Table 3 presents estimated victims per highway crash, by truck/bus type, crash severity, and police-reported injury severity. As mentioned earlier, estimates for fatal crashes came from FARS. Truck-tractors with two or three trailers involved in a fatal crash caused more deaths than any other truck configuration – an average of 1.118 people had fatal injuries in a typical crash. The unweighted and weighted GES counts of people involved in truck/bus crashes by vehicle type and police-reported severity are presented in Tables 4 through 7. The number of people killed in fatal truck/bus crashes is presented in Table 8. The GES tables reveal adequate cell sizes (a minimum of 10 and preferably 30 cases per cell) except when trailer information is unknown. Given the cell sizes, when information about trailers is unknown, it is advisable to use the average cost per large truck crash rather than a configuration-specific cost.

Table 9 presents the average estimated costs per victim injured by vehicle type and injury severity. These costs vary modestly with vehicle type. Their

estimation was an intermediate step toward estimating costs per crash. Table 10 provides detailed cost per crash estimates for different truck/bus configurations and crash severity.

Tables 11 presents the estimated costs per crash for all crashes and Table 12 presents the estimated costs per crash for injury crashes only. The $117,309 average cost per crash for vehicles with two or three trailers far exceeds the $84,587 for a tractor-trailer crash. Bus crashes and crashes where trailer presence was unknown have the lowest average costs.

Crashes involving bobtails have higher average costs than straight truck crashes. The reason for the finding is unclear. These vehicles could have stability problems. Alternatively, since their engines are far more powerful than their trailer-less weight demands, they may be driven aggressively. Also, since bobtail drivers are not generating revenue and are often not paid, they may face financial incentives to speed. We also conducted a sensitivity analysis, using the travel delay costs from Miller, Viner et al. (1991) instead of the new estimates. The resulting crash costs are presented in the appendix. On a percentage basis costs for low-severity crashes are much more sensitive to this change than costs for severe crashes.

Table 13 shows the total cost of police-reported heavy vehicle crashes captured in 1997 GES data. The costs of large truck crashes in 1997 exceeded $24 billion. That total included $8.7 billion in productivity losses, $2.5 billion in resource costs, and quality of life losses valued at $13.1 billion. The largest share of this total was the $13.2 billion in costs of single-trailer combination trucks. Bobtail crashes cost about one thirty-seventh this much, meaning that bobtails would be over- (or under-) represented in crashes if they comprise less (or more) than about 2.7% of combination truck traffic. Similarly, combination trucks with multiple trailers accounted for about 7.6% of combination truck crash costs. Single straight trucks accounted for $8.2 billion dollars of the truck crash costs, about one third. Bus crashes were a much smaller factor than truck crashes, costing less than $1 billion in 1997.

Computed with 1997 Vehicle Inventory and Use Survey (VIUS) data on truck mileage (Bureau of the Census, 1999), the crash costs per 1,000 truck miles are $259 for single unit trucks, $138 for single combination trucks, and $134 for multiple combinations.

TABLE 2. The Average Number of People Involved in a Truck/Bus Crash by Truck/Bus Type and Police-Reported Injury Severity (1988-1997)

Truck/Bus Type	No injury	Posibble injury	Non incapacitating	Incapacitating	Fatal injury	Unknown severity	Unknown if injured
Straight truck, no trailer	1.993	0.198	0.108	0.059	0.008	0.005	0.059
Straight truck with trailer	2.004	0.138	0.096	0.054	0.010	0.002	0.095
Straight truck, unknown if with trailer	1.547	0.018	0.041	0.017			0.765
Bobtail	1.966	0.163	0.110	0.060	0.010	0.003	0.054
Truck-tractor, 1 trailer	1.836	0.156	0.099	0.067	0.015	0.003	0.073
Truck-tractor, 2 or 3 trailers	1.656	0.180	0.121	0.058	0.027	0.002	0.079
Truck-tractor, with unknown # of trailers	1.936	0.058	0.012	0.043	0.012		0.233
Medium/heavy truck, unknown if with trailer	1.611	0.161	0.058	0.041	0.002	0.003	0.307
All large trucks	1.903	0.171	0.102	0.062	0.012	0.004	0.072
Bus, transit/intercity	2.253	0.380	0.101	0.049	0.003	0.023	0.120

Source: GES

TABLE 3. The Average Number of People Involved in a Truck/Bus Crash by Truck/Bus Type, Crash Severity, and Police-Reported Injury Severity (1988-1997)

Truck/Bus Type	Maximum severity in crash: No injury	Maximum severity in crash: Possible injury			
		No injury	Posibble injury	Unknown severity	Unknown if injured
Straight truck, no trailer	2.310	1.529	1.309	0.002	0.025
Straight truck with trailer	2.277	1.558	1.208	-	0.059
Straight truck, unknown if with trailer	2.003	1.153	1.005	-	0.382
Bobtail	2.238	1.483	1.218	-	0.033
Truck-tractor, 1 trailer	2.123	1.371	1.242	0.002	0.045
Truck-tractor, 2 or 3 trailers	1.895	1.400	1.225	-	0.071
Truck-tractor, with unknown # of trailers	2.323	0.720	1.053	-	0.132
Medium/heavy truck, unknown if with trailer	1.956	1.123	1.476	-	0.236
All large trucks	2.202	1.445	1.270	0.002	0.039
Bus, transit/intercity	2.543	1.683	1.765	0.005	0.081

	Maximum severity in crash: Non incapacitating				
	No injury	Posibble injury	Non incapacitating	Unknown severity	Unknown if injured
Straight truck, no trailer	1.154	0.275	1.194	0.002	0.033
Straight truck with trailer	1.209	0.144	1.137	0.002	0.061
Straight truck, unknown if with trailer	1.320	0.122	1.213	0.000	0.478
Bobtail	1.320	0.266	1.302	-	0.029
Truck-tractor, 1 trailer	1.110	0.198	1.143	0.003	0.034
Truck-tractor, 2 or 3 trailers	1.262	0.255	1.176	0.001	0.011
Truck-tractor, with unknown # of trailers	1.272	0.411	1.074	-	0.208
Medium/heavy truck, unknown if with trailer	1.180	0.164	1.237	-	0.101
All large trucks	1.145	0.230	1.172	0.002	0.035
Bus, transit/intercity	1.853	0.779	1.345	0.048	0.132

	Maximum severity in crash: : Incapacitating					
	No injury	Posibble injury	Non incapacitating	Incapacitating	Unknown severity	Unknown if injured
Straight truck, no trailer	1.115	0.211	0.245	1.220	0.010	0.021
Straight truck with trailer	1.770	0.199	0.047	1.184	-	0.010
Straight truck, unknown if with trailer	0.290	0.225	0.225	1.003	-	0.484
Bobtail	1.085	0.184	0.236	1.157	-	0.021
Truck-tractor, 1 trailer	1.016	0.148	0.136	1.170	0.005	0.022
Truck-tractor, 2 or 3 trailers	1.005	0.200	0.167	1.107	-	0.100
Truck-tractor, with unknown # of trailers	1.819	-	-	1.021	-	-
Medium/heavy truck, unknown if with trailer	0.354	0.316	0.350	1.927	-	0.020
All large trucks	1.076	0.175	0.179	1.190	0.006	0.022
Bus, transit/intercity	1.417	0.938	0.260	1.361	0.071	0.036

	Maximum severity in crash: Fatal						
	No injury	Posibble injury	Non incapacitating	Incapacitating	Fatal	Unknown severity	Unknown if injured
Straight truck, no trailer	0.828	0.236	0.28491	0.353	1.108	0.007	0.006
Straight truck with trailer	0.936	0.231	0.30631	0.317	1.081	0.026	0.002
Straight truck, unknown if with trailer	0.955	0.273	0.36364	0.227	1.000	-	-
Bobtail	0.782	0.241	0.2455	0.326	1.112	0.008	0.008
Truck-tractor, 1 trailer	0.866	0.221	0.28035	0.337	1.109	0.007	0.009
Truck-tractor, 2 or 3 trailers	0.855	0.237	0.3043	0.295	1.118	0.007	0.007
Truck-tractor, with unknown # of trailers	0.961	0.353	0.17647	0.348	1.054	0.015	0.059
Medium/heavy truck, unknown if with trailer	0.884	0.390	0.14938	0.357	1.058	0.017	0.050
All large trucks	0.856	0.227	0.279	0.337	1.108	0.078	0.087
Bus, transit/intercity	0.872	1.175	0.795	0.477	1.110	0.106	0.013

	Maximum severity in crash: Unknown severity			Maximum severity in crash: Unknown if injured	
	No injury	Unknown severity	Unknown if injured	No injury	Unknown if injured
Straight truck, no trailer	1.334	1.265	0.099	1.137	1.075
Straight truck with trailer	3.390	1.061	0.049	1.139	1.081
Straight truck, unknown if with trailer	-	-	-	0.105	3.686
Bobtail	0.966	1.030	-	1.220	1.033
Truck-tractor, 1 trailer	0.875	1.137	0.042	1.326	1.028
Truck-tractor, 2 or 3 trailers	0.052	1.000	-	1.129	1.013
Truck-tractor, with unknown # of trailers	-	-	-	1.209	1.003
Medium/heavy truck, unknown if with trailer	3.370	2.780	0.593	1.202	1.082
All large trucks	1.149	1.198	0.069	1.241	1.051
Bus, transit/intercity	1.716	3.216	0.063	1.710	1.158

Source: GES and FARS

TABLE 4. The Unweighted Count of Truck Occupants Involved in Crashes by Truck/Bus Type and Police-Reported Injury Severity (1988-1997)

Truck/Bus Type	No injury	Posibble injury	Non incapacitating	Incapacitating	Fatal injury	Unknown severity	Unknown if injured
Straight truck, no trailer	21,139	2,139	1,278	602	43	47	546
Straight truck with trailer	2,373	177	104	84	7	3	83
Straight truck, unknown if with trailer	21	1	2	0	0	0	12
Bobtail	2,545	190	157	76	12	4	73
Truck-tractor, 1 trailer	37,288	2,488	1,705	841	111	57	1,478
Truck-tractor, 2 or 3 trailers	1,267	97	51	27	3	1	31
Truck-tractor, with unknown # of trailers	118	4	3	4	1	0	30
Medium/heavy truck, unknown if with trailer	483	47	8	10	1	0	127
All large trucks	65,234	5,143	3,308	1,644	178	112	2,380
Bus, transit/intercity	2,535	1,175	242	141	3	126	157

Source: GES

TABLE 5. The Unweighted Count of Non Truck Occupants Involved in Truck/Bus Crashes by Truck/Bus Type and Police-Reported Injury Severity (1988-1997)

Truck/Bus Type	No injury	Posibble injury	Non incapacitating	Incapacitating	Fatal injury	Unknown severity	Unknown if injured
Straight truck, no trailer	14,964	5,807	3,535	2,076	295	162	483
Straight truck with trailer	1,686	603	370	212	31	6	68
Straight truck, unknown if with trailer	21	4	8	3	0	0	4
Bobtail	2,058	696	477	249	32	7	63
Truck-tractor, 1 trailer	27,914	10,810	6,536	3,892	686	198	1,089
Truck-tractor, 2 or 3 trailers	939	384	244	128	29	2	45
Truck-tractor, with unknown # of trailers	140	27	14	7	1	0	5
Medium/heavy truck, unknown if with trailer	453	169	99	40	4	7	18
All large trucks	48,175	18,500	11,283	6,607	1,078	382	1,775
Bus, transit/intercity	1,796	522	414	207	19	14	89

Source: GES

TABLE 6. The Weighted Count of Truck Occupants Involved in Crashes by Truck/Bus Type and Police-Reported Injury Severity (1988-1997)

Truck/Bus Type	No injury	Posibble injury	Non incapacitating	Incapacitating	Fatal injury	Unknown severity	Unknown if injured
Straight truck, no trailer	1,403,201	67,258	40,221	19,223	1,764	2,007	46,936
Straight truck with trailer	134,164	3,307	2,912	2,265	99	18	8,865
Straight truck, unknown if with trailer	1,352	6	16	0	0	0	364
Bobtail	204,519	6,637	5,558	2,531	471	53	7,233
Truck-tractor, 1 trailer	1,657,786	56,991	45,830	25,364	3,003	1,753	86,786
Truck-tractor, 2 or 3 trailers	43,308	2,394	1,065	440	155	89	2,327
Truck-tractor, with unknown # of trailers	11,299	309	16	255	93	0	1,970
Medium/heavy truck, unknown if with trailer	34,399	1,786	150	989	55	0	14,120
All large trucks	3,490,028	138,688	95,768	51,067	5,640	3,921	168,600
Bus, transit/intercity	299,571	58,285	9,692	4,050	298	4,740	13,588

Source: GES

TABLE 7. The Weighted Count of Non Truck Occupants Involved in Truck/Bus Crashes by Truck/Bus Type and Police-Reported Injury Severity (1988-1997)

Truck/Bus Type	No injury	Posibble injury	Non incapacitating	Incapacitating	Fatal injury	Unknown severity	Unknown if injured
Straight truck, no trailer	1,153,704	186,354	98,000	56,327	8,086	4,968	29,100
Straight truck with trailer	113,112	13,713	8,878	4,425	1,182	176	2,823
Straight truck, unknown if with trailer	1,308	24	54	30	0	0	952
Bobtail	182,888	25,525	16,023	9,374	1,541	564	3,495
Truck-tractor, 1 trailer	1,458,873	207,263	121,684	88,107	22,428	4,136	36,862
Truck-tractor, 2 or 3 trailers	34,826	6,119	4,635	2,317	1,118	11	1,412
Truck-tractor, with unknown # of trailers	12,101	393	133	260	46	0	843
Medium/heavy truck, unknown if with trailer	42,615	5,928	2,609	990	31	140	552
All large trucks	2,999,427	445,319	252,017	161,830	34,432	9,994	76,039
Bus, transit/intercity	244,674	33,599	14,783	7,793	526	882	15,387

Source: GES

TABLE 8. The Number of People Killed in Truck/Bus Crashes by Truck/Bus Type (1988-1997)

Truck/Bus Type	Number of fatal crashes	Truck occupants killed in crashes	Non-truck occupants killed in crashes	Total number of people killed in crashes
Straight truck, no trailer	7427	1105	7122	8227
Straight truck with trailer	1000	141	940	1081
Straight truck, unknown if with trailer	22	4	18	22
Bobtail	2664	455	2507	2962
Truck-tractor, 1 trailer	28756	4181	27706	31887
Truck-tractor, 2 or 3 trailers	1745	286	1665	1951
Truck-tractor, with unknown # of trailers	204	22	193	215
Medium/heavy truck, unknown if with trailer	241	28	227	255
All large trucks	42059	6221	40378	46599
Bus, transit/intercity	1348	80	1416	1496

Source: FARS

TABLE 9. Costs per Victim Injured by Truck/Bus Type and Police-Reported Injury Severity (in 1999 dollars)

Truck/bus type	Injury severity	Medical costs	Emergency services	Property damage	Lost productivity from delays	Total lost productivity	Monetized QALYs	Total
Straight truck, no trailer	No injury	73	33	1,276	3,152	3,430	262	5,074
	Possible injury	1,144	103	2,469	13,803	16,376	5,802	25,895
	Non incapacitating	4,027	223	3,808	13,803	24,511	28,956	61,525
	Incapacitating	35,810	404	4,972	13,803	58,688	242,344	342,217
	Fatal injury	16,843	1,355	12,123	25,751	775,733	2,002,242	2,808,296
	Unknown severity	1,725	128	2,882	13,803	17,021	8,466	30,222
	Unknown if injured	1,466	90	1,983	0	3,827	8,382	15,748
Straight truck with trailer	No injury	93	32	1,258	3,152	3,455	388	5,227
	Possible injury	2,886	172	3,386	13,803	20,325	15,581	42,350
	Non incapacitating	5,132	232	3,967	13,803	27,079	41,619	78,029
	Incapacitating	15,660	374	4,834	13,803	43,668	146,239	210,777
	Fatal injury	17,176	1,355	12,123	25,751	873,351	2,247,819	3,151,825
	Unknown severity	11,339	215	3,522	13,803	33,418	83,487	131,981
	Unknown if injured	1,018	71	1,814	0	2,177	6,128	11,209
Straight truck, unknown if with trailer	No injury	73	30	1,218	3,152	3,410	305	5,035
	Possible injury	3,044	174	3,376	13,803	21,268	15,717	43,579
	Non incapacitating	4,835	229	3,977	13,803	27,326	41,632	77,998
	Incapacitating	18,263	393	4,975	13,803	56,685	187,669	267,986
	Fatal injury	22,642	1,355	12,123	25,751	855,695	2,038,329	2,930,144
	Unknown if injured	1,003	67	1,755	0	2,081	6,580	11,486
Bobtail	No injury	71	32	1,264	3,152	3,421	253	5,041
	Possible injury	1,106	102	2,442	13,803	16,320	5,615	25,585
	Non incapacitating	3,967	223	3,804	13,803	24,709	29,050	61,753
	Incapacitating	38,480	405	4,985	13,803	62,934	269,782	376,586
	Fatal injury	16,936	1,336	11,954	25,390	861,124	2,216,350	3,107,700
	Unknown severity	1,657	126	2,836	13,803	17,014	8,710	30,344
	Unknown if injured	1,468	91	1,998	0	3,953	8,464	15,974
Truck-tractor, 1 trailer	No injury	91	32	1,255	3,152	3,451	376	5,205
	Possible injury	2,906	172	3,380	13,803	20,495	15,803	42,757
	Non incapacitating	5,285	234	3,975	13,803	27,189	41,834	78,517
	Incapacitating	15,467	370	4,803	13,803	43,051	142,888	206,578
	Fatal injury	16,876	1,355	12,123	25,751	875,662	2,143,403	3,049,419
	Unknown severity	6,119	137	2,481	13,803	25,731	46,002	80,470
	Unknown if injured	1,034	72	1,832	0	2,259	6,285	11,483
Truck-tractor, 2 or 3 trailers	No injury	97	33	1,267	3,152	3,463	391	5,252
	Possible injury	2,926	173	3,382	13,803	20,573	15,639	42,692
	Non incapacitating	5,283	234	3,968	13,803	27,196	42,920	79,601
	Incapacitating	15,257	370	4,805	13,803	44,044	144,337	208,813
	Fatal injury	16,748	1,355	12,123	25,751	833,139	2,033,696	2,897,062
	Unknown severity	333	35	1,277	13,803	14,499	1,645	17,789
	Unknown if injured	1,041	74	1,861	0	2,323	6,246	11,545
Truck-tractor, with unknown # of trailers	No injury	90	32	1,253	3,152	3,437	364	5,176
	Possible injury	2,967	172	3,376	13,803	21,091	16,171	43,777
	Non incapacitating	5,478	237	4,007	13,803	25,773	40,381	75,877
	Incapacitating	16,060	361	4,727	13,803	45,993	130,854	197,996
	Fatal injury	16,850	1,355	12,123	25,751	802,460	1,864,977	2,697,765
	Unknown if injured	1,000	65	1,721	0	2,022	6,460	11,268
Medium/heavy truck, unknown if with trailer	No injury	76	30	1,225	3,152	3,414	316	5,062
	Possible injury	2,822	171	3,392	13,803	20,059	15,618	42,062
	Non incapacitating	4,782	226	3,935	13,803	25,907	37,534	72,385
	Incapacitating	14,788	365	4,774	13,803	43,224	149,144	212,296
	Fatal injury	17,833	1,355	12,123	25,751	580,980	1,822,465	2,434,756
	Unknown severity	3,063	71	1,597	13,803	20,849	22,679	48,260
	Unknown if injured	1,015	68	1,764	0	2,144	6,486	11,477
All large trucks	No injury	85	32	1,262	3,152	3,443	335	5,157
	Possible injury	2,246	146	3,039	13,803	18,947	12,048	36,427
	Non incapacitating	4,804	230	3,912	13,803	26,183	37,012	72,141
	Incapacitating	22,977	382	4,866	13,803	48,960	180,352	257,537
	Fatal injury	16,889	1,355	12,123	25,751	846,510	2,100,377	2,977,254
	Unknown severity	4,177	133	2,658	13,803	21,855	29,374	58,197
	Unknown if injured	1,154	77	1,871	0	2,694	6,879	12,675
Bus, transit/intercity	No injury	14	23	1,100	126	223	34	1,394
	Possible injury	2,440	168	3,600	219	5,613	13,818	25,639
	Non incapacitating	5,807	251	4,108	221	16,876	58,175	85,217
	Incapacitating	10,275	298	4,503	231	21,495	103,396	139,968
	Fatal injury	22,642	1,355	12,123	569	792,728	2,074,193	2,903,041
	Unknown severity	1,328	161	3,603	222	4,119	6,215	15,425
	Unknown if injured	1,113	77	1,958	158	2,378	6,212	11,739

TABLE 10. Costs per Crash by Truck/Bus Type and Crash Severity (in 1999 dollars)

TRUKTYPE	Maximum severity in crash	Medical cost	Emergency services	Property damage	Lost productivity from delays	Total lost productivity	Monetized QALYs	Total
Straight truck, no trailer	No injury	160	74	2,911	7,280	7,890	571	11,605
	Possible injury	1,648	189	5,255	22,911	26,801	8,122	42,015
	Non incapacitating	5,276	338	6,808	23,945	37,890	36,904	87,216
	Incapacitating	44,643	611	9,051	26,780	85,031	302,291	441,625
	Fatal injury	35,371	1,772	18,087	43,292	907,658	2,352,174	3,315,062
	Unknown severity	2,540	213	5,457	21,670	27,009	12,982	48,202
	Unknown if injured	1,673	133	3,541	3,584	8,027	9,271	22,645
Straight truck with trailer	No injury	206	73	2,855	7,177	7,854	863	11,851
	Possible injury	3,717	263	6,167	21,587	30,022	19,601	59,769
	Non incapacitating	6,433	333	6,641	21,517	38,065	50,336	101,808
	Incapacitating	19,593	548	8,858	25,318	63,482	179,748	272,229
	Fatal injury	25,677	1,731	17,933	42,974	908,354	2,261,505	3,215,199
	Unknown severity	15,375	348	7,892	25,324	51,966	113,546	189,126
	Unknown if injured	1,203	114	3,398	3,589	6,241	6,955	17,911
Straight truck, unknown if with trailer	No injury	146	60	2,441	6,313	6,842	626	10,115
	Possible injury	2,109	154	3,891	11,006	15,663	11,120	32,937
	Non incapacitating	6,654	364	7,589	22,588	40,643	55,252	110,501
	Incapacitating	14,282	387	6,071	16,039	50,901	138,716	210,358
	Fatal injury	24,118	1,542	16,236	39,510	656,642	1,709,226	2,407,764
	Unknown if injured	3,741	278	6,980	330	8,380	23,999	43,378
Bobtail	No injury	155	72	2,817	7,053	7,640	549	11,233
	Possible injury	1,509	176	4,930	21,493	25,123	7,376	39,113
	Non incapacitating	5,604	364	7,362	25,807	41,183	40,039	94,552
	Incapacitating	45,630	577	8,543	25,183	85,637	319,826	460,214
	Fatal injury	36,033	1,761	17,849	42,411	961,899	2,420,455	3,437,995
	Unknown severity	1,825	162	4,150	17,255	20,802	9,335	36,274
	Unknown if injured	1,540	127	3,513	3,846	7,891	8,728	21,799
Truck-tractor, 1 trailer	No injury	191	68	2,660	6,691	7,319	788	11,025
	Possible injury	3,810	262	6,010	21,500	30,368	20,489	60,939
	Non incapacitating	6,761	341	6,683	22,044	39,059	51,444	104,287
	Incapacitating	19,360	525	7,992	23,343	60,848	176,511	265,237
	Fatal injury	26,308	1,761	18,057	42,962	956,183	2,365,564	3,367,873
	Unknown severity	7,444	184	3,879	18,453	32,449	54,492	98,448
	Unknown if injured	1,186	118	3,557	4,180	6,905	6,929	18,693
Truck-tractor, 2 or 3 trailers	No injury	183	62	2,399	5,973	6,562	735	9,940
	Possible injury	3,796	262	6,040	21,315	30,212	20,066	60,377
	Non incapacitating	7,083	362	7,163	23,747	41,352	54,166	110,125
	Incapacitating	18,472	525	8,129	23,521	61,094	171,808	260,026
	Fatal injury	25,751	1,764	18,091	43,130	1,034,892	2,462,275	3,542,774
	Unknown severity	504	44	1,447	13,966	14,997	2,491	19,483
	Unknown if injured	1,108	107	3,199	3,558	6,135	6,414	16,962
Truck-tractor, with unknown # of trailers	No injury	209	74	2,908	7,324	7,971	817	11,979
	Possible injury	3,172	203	4,479	16,030	23,902	17,583	49,339
	Non incapacitating	7,421	382	7,681	24,513	41,072	51,591	108,146
	Incapacitating	15,383	403	6,795	18,954	52,043	131,674	206,299
	Fatal injury	24,588	1,689	17,640	42,482	941,168	2,260,946	3,246,030
	Unknown if injured	1,123	106	3,275	3,812	6,224	6,933	17,660
Medium/heavy truck, unknown if with trailer	No injury	142	59	2,381	6,166	6,652	574	9,807
	Possible injury	4,506	303	6,805	23,912	33,852	24,865	70,330
	Non incapacitating	6,541	351	7,070	23,059	39,477	48,953	102,392
	Incapacitating	31,317	853	12,130	36,905	101,557	313,119	458,976
	Fatal injury	25,946	1,703	17,704	42,633	911,627	2,291,273	3,248,252
	Unknown severity	9,424	345	9,695	49,008	70,826	68,285	158,574
	Unknown if injured	1,197	111	3,399	3,787	6,446	7,402	18,556
All large trucks	No injury	182	70	2,764	6,939	7,565	718	11,299
	Possible injury	3,051	237	5,778	22,114	29,228	16,124	54,419
	Non incapacitating	6,285	344	6,813	23,000	39,084	46,694	99,220
	Incapacitating	28,685	560	8,454	24,791	70,269	224,204	332,172
	Fatal injury	28,429	1,757	17,975	42,987	969,247	2,401,793	3,419,202
	Unknown severity	5,357	199	4,669	20,156	30,392	36,814	77,431
	Unknown if injured	1,326	121	3,525	3,913	7,114	7,630	19,716
Bus, transit/intercity	No injury	36	60	2,800	8,017	8,267	91	11,253
	Possible injury	4,547	345	8,404	29,743	40,075	26,131	79,502
	Non incapacitating	10,039	528	10,790	35,827	63,233	91,357	175,947
	Incapacitating	17,331	672	12,467	40,771	77,856	161,980	270,305
	Fatal injury	29,936	2,075	24,574	66,573	952,161	2,342,427	3,351,173
	Unknown severity	4,303	555	13,442	49,799	61,946	19,499	99,745
	Unknown if injured	1,216	121	3,982	5,391	7,969	7,170	20,458

TABLE 11. Costs per Crash by Truck/Bus Type (in 1999 dollars)

Truck/bus type	Medical costs	Emergency services	Property damage	Lost productivity from delays	Total lost productivity	Monetized QALYs	Total
Straight truck, no trailer	3,139	150	3,959	11,583	22,444	34,973	64,667
Straight truck with trailer	2,217	152	3,933	10,577	24,012	38,889	69,203
Straight truck, unknown if with trailer	1,448	117	3,535	5,921	9,340	10,741	25,181
Bobtail	3,341	148	3,843	11,103	25,163	42,200	74,695
Truck-tractor, 1 trailer	2,525	160	3,868	10,657	28,466	49,568	84,588
Truck-tractor, 2 or 3 trailers	2,754	178	3,947	10,910	37,993	72,437	117,309
Truck-tractor, with unknown # of trailers	1,527	121	3,414	7,959	19,906	30,784	55,751
Medium/heavy truck, unknown if with trailer	1,819	128	3,515	8,763	13,786	16,699	35,948
All large trucks	2,769	156	3,913	10,993	25,760	43,039	75,637
Bus, transit/intercity	2,270	174	4,844	14,837	22,900	24,267	54,455

TABLE 12. Costs per Injury Crash by Truck/Bus Type (in 1999 dollars)

Truck/bus type	Medical costs	Emergency services	Property damage	Lost productivity from delays	Total lost productivity	Monetized QALYs	Total
Straight truck, no trailer	9,746	315	6,212	21,150	54,735	111,394	182,404
Straight truck with trailer	6,816	332	6,383	18,377	61,050	126,080	200,662
Straight truck, unknown if with trailer	4,977	272	6,503	4,859	16,144	38,191	66,087
Bobtail	11,111	334	6,321	20,993	67,922	143,876	229,565
Truck-tractor, 1 trailer	7,626	360	6,502	19,332	74,716	156,268	245,472
Truck-tractor, 2 or 3 trailers	7,797	405	6,980	20,600	99,679	213,148	328,008
Truck-tractor, with unknown # of trailers	4,133	213	4,408	9,218	43,510	90,072	142,337
Medium/heavy truck, unknown if with trailer	4,105	222	5,045	12,316	23,511	38,699	71,581
All large trucks	8,448	343	6,409	19,908	65,739	136,066	217,005
Bus, transit/intercity	6,241	378	8,481	26,952	48,896	67,218	131,214

TABLE 13. Total Crash Costs by Truck/Bus Type: 1997 (in 1999 dollars)

Truck/bus type	Medical costs	Emergency services	Property damage	Lost productivity from delays	Total lost productivity	Monetized QALYs	Total
Straight truck, no trailer	410,925,609	21,925,212	605,615,580	1,754,633,438	3,023,590,965	4,097,371,035	8,159,428,402
Straight truck with trailer	48,903,125	2,912,334	70,427,328	195,646,027	468,812,579	815,743,198	1,406,798,564
Straight truck, unknown if with trailer	-	-	-	-	-	-	-
Bobtail	19,668,249	1,367,907	40,435,116	125,570,523	164,578,498	126,436,920	352,486,690
Truck-tractor, 1 trailer	436,023,967	29,575,165	763,765,923	2,077,019,020	4,665,005,936	7,271,946,362	13,166,317,352
Truck-tractor, 2 or 3 trailers	19,805,517	1,301,041	25,671,809	66,897,451	365,454,447	779,751,440	1,191,984,254
Truck-tractor, with unknown # of trailers	1,644,565	150,998	4,657,117	6,599,714	10,173,215	10,308,955	26,934,849
Medium/heavy truck, unknown if with trailer	3,665,223	314,045	9,387,909	24,692,838	33,706,475	25,075,241	72,148,893
All large trucks	940,636,254	57,546,702	1,519,960,782	4,251,059,012	8,731,322,115	13,126,633,151	24,376,099,004
Bus, transit/intercity	36,167,501	3,228,524	93,226,729	283,158,870	432,821,334	412,292,371	977,736,458

References

AAAM. (1985) The Abbreviated Injury Scale 1985. Des Plaines IL: Association for the Advancement of Automotive Medicine.

AAAM. (1990) The Abbreviated Injury Scale 1990. Des Plaines IL: Association for the Advancement of Automotive Medicine.

Berkowitz, M.; Harvey, C.; Greene, C.; Wilson, and S. (1990) The economic consequences of spinal cord injury, Paralysis Society of America of the Paralyzed Veterans of America, Washington, DC.

Bureau of the Census (1994) *Statistical Abstract of the United states 1994.* U.S. Government Printing Office, Washington, DC.

Bureau of the Census (1999) *1997 Economic Census - Vehicle Inventory and Use Survey.* U.S. Government Printing Office, Washington, DC.

Blincoe, L.J. (1996) *The Economic Costs of Motor Vehicle Crashes 1994.* Washington, DC: National Highway Traffic Safety Administration, DOT HS 808 425.

Blincoe, L.J.; Faigin, B.M. (1992) The Economic Cost of Motor Vehicle Crashes, 1990. Washington DC: National Highway Traffic Safety Administration, DOT HS 807 876.

Council of Economic Advisers (2000). *Economic Report of the President*. US Government Printing Office, Washington, DC.

Krusei, F. E. and McFadden, N.E. (1996) *Update of Value of Life and Injuries for Use in Preparing Economic Evaluations.* Office of the Secretary of Transportation, Washington, DC

Garthe, E.A., Ferguson, S.A., and Early, N. (1996) A Method for Converting Injury Severity in NASS93 (AIS90) to NASS88 (AIS 85), in *40th Annual Proceedings, Association for the Advancement of Automotive Medicine*, AAAM, Des Plaines IL, 477-494.

Hensler, D.R., Marquis, M.S., Abrahams, A.F., Berry, S.H., Ebener, P.A., Lewis, E.G., Ling, E.A., MacCoun, R.J., Manning, W.G., Rogowski, J.A., and Vaiana, M.E. (1991) Compensation For Accidental Injuries In The United States, Report R-3999-HHS/ICJ, RAND: Santa Monica, CA.

Kakalik, JS, and Pace, NM (1986) Costs And Compensation Paid In Tort Litigation, Report R-3391-ICJ, RAND: Santa Monica, CA.

Lan, Chang-Jen and Hu, Patricia S. (2000) Personal communications.

Lawrence, B., Miller, T.R., Jensen, A. Fisher, D., and Zamula, W. (1999) Estimating the Costs of Nonfatal Consumer Product Injuries in the United

States, *Proceedings of the 7th International Conference on Product Safety Research*, 40-68

McCormick W. and Shane J. (1993) *Treatment of Value of Life and Injuries in Preparing Economic Evaluations.* Office of the Secretary of Transportation, Washington, DC

Miller, T.R. (1993) Costs and Functional Consequences of US Roadway Crashes. *Accident Analysis and Prevention*. **25,** 593-607.

Miller, T.R. (1997) Societal Costs of Transportation Crashes, in *The Full Social Costs and Benefits of Transportation*, D Greene, D Jones, M Delucchi, ed., Springer-Verlag, Heidelberg, 281-314.

Miller, T.R.; Blincoe, L.J. (1994) Incidence and Cost of Alcohol-Involved Crashes in the United States. *Accident Analysis and Prevention* **26**:583-592.

Miller, T.R., Galbraith, M.S., Lestina D.C., Schlax T., Mabery P., Deering R., Massie D., Campbell K. (1995) Understanding the Harm from US Motor Vehicle Crashes. *39th Proceedings, A.A.A.M., Des Plaines, IL* :327-342.

Miller, T.R., B Lawrence, B., A Jensen, A., Waehrer, G., Spicer, R., Lestina, D. Cohen, M. (1998) Estimating the Cost to Society of Consumer Product Injuries: The Revised Injury Cost Model: US Consumer Product Safety Commission. Bethesda, MD.

Miller, T.R., Lestina, D.C. and Spicer, R.S. (1998) Highway Crash Costs in the United States by Driver age, Blood Alcohol Level, Victim Age and Restraint Use. *Accident Analysis and Prevention* **30,** 2, 137-150.

Miller, T.R., Levy, D.T., Spicer, R.S., Lestina, D.C. (1998) Allocating the Costs of Motor Vehicle Crashes Between Vehicle Types, *Transportation Research Record*, 1635, 81-87.

Miller, T.; Pindus, N.; Douglass, J. Motor vehicle injury costs by body region and severity, J. Trauma 34:270-275; 1993.

Miller, T.R., Pindus, N.; Douglass, J.; Rossman, S. (1995) Databook on Nonfatal Injury -- Incidence, Costs, and Consequences. The Urban Institute Press: Washington D.C.

Miller, T.R., Romano, E., and Spicer, R.S. (2000) The Cost of Unintentional Childhood Injuries and the Value of Prevention, *The Future of Children*, **10**,1, 137-163.

Miller, T.R., Spicer R.S., D Lestina, D.C. and Levy, D.T. (1999) Is It Safest to Travel By Bicycle, Car or Big Truck?, *Journal of Crash Prevention and Injury Control*, 1:1, 25-34.

Miller, T. R., Viner, J., Rossman, S., Pindus, N., Gellert, W., Dillingham, A., and Blomquist, G. (1991) *The Costs of Highway Crashes.* The Urban Institute, Washington DC.

Miller T. R., Whiting, B., Kragh, B., and Zegeer, C. (1987) Sensitivity of a Highway Safety Resource Allocation Model to Variations in Benefit Computation Parameters, *Transportation Research Record* 1124, 58-65.

National Highway Traffic Safety Administration (1995) National Accident Sampling System Crashworthiness Data System 1991-1993. Washington, D.C.

National Highway Traffic Safety Administration (1987) National Accident Sampling System 1986. Washington, D.C.

National Safety Council. (1990) Manual on Classification of Motor Vehicle Traffic Accidents, Fifth Edition (ANSI D-16.1-1989). Itasca, IL.

O'Day, J., ed. (1993) Accident data quality: A Synthesis of Highway Practice. National Cooperative Highway Research Program Synthesis 192, Transportation Research Board, National Research Council, National Academy Press: Washington, DC.

Rice, D., MacKenzie, E. and Associates. Cost of injury in the United States: a report to Congress, Institute for Health & Aging, University of California, and Injury Prevention Center, The Johns Hopkins University, San Francisco, CA, 1989.

U.S. DOT. (1997) The Value of Travel Time: Departmental Guidance for

Conducting Economic Evaluations.

Viner, J.G.; Conley, C. Consistency Of Police Reported "Incapacitating Injuries" Between States. Working Paper; Federal Highway Administration; 1994.

Appendix

TABLE 9-A. Costs per Victim Injured by Truck/Bus Type and Police-Reported Injury Severity (in 1999 dollars)

Truck/bus type	Injury severity	Medical costs	Emergency services	Property damage	Lost productivity from delays	Total lost productivity	Monetized QALYs	Total
Straight truck, no trailer	No injury	73	33	1,276	132	411	262	2,054
	Possible injury	1,144	103	2,469	178	2,751	5,802	12,270
	Non incapacitating	4,027	223	3,808	225	10,933	28,956	47,947
	Incapacitating	35,810	404	4,972	233	45,118	242,344	328,647
	Fatal injury	16,843	1,355	12,123	569	750,551	2,002,242	2,783,114
	Unknown severity	1,725	128	2,882	193	3,411	8,466	16,612
	Unknown if injured	1,466	90	1,983	158	3,985	8,382	15,906
Straight truck with trailer	No injury	93	32	1,258	132	435	388	2,207
	Possible injury	2,886	172	3,386	211	6,733	15,581	28,758
	Non incapacitating	5,132	232	3,967	229	13,504	41,619	64,455
	Incapacitating	15,660	374	4,834	233	30,099	146,239	197,207
	Fatal injury	17,176	1,355	12,123	569	848,170	2,247,819	3,126,644
	Unknown severity	11,339	215	3,522	199	19,814	83,487	118,377
	Unknown if injured	1,018	71	1,814	152	2,329	6,128	11,361
Straight truck, unknown if with trailer	No injury	73	30	1,218	130	388	305	2,014
	Possible injury	3,044	174	3,376	211	7,676	15,717	29,987
	Non incapacitating	4,835	229	3,977	230	13,753	41,632	64,425
	Incapacitating	18,263	393	4,975	234	43,117	187,669	254,417
	Fatal injury	22,642	1,355	12,123	569	855,695	2,038,329	2,930,144
	Unknown if injured	1,003	67	1,755	150	2,231	6,580	11,636
Bobtail	No injury	71	32	1,264	132	401	253	2,021
	Possible injury	1,106	102	2,442	177	2,694	5,615	11,958
	Non incapacitating	3,967	223	3,804	225	11,131	29,050	48,175
	Incapacitating	38,480	405	4,985	233	49,364	269,782	363,015
	Fatal injury	17,176	1,355	12,123	569	855,695	2,247,819	3,134,169
	Unknown severity	1,657	126	2,836	191	3,403	8,710	16,732
	Unknown if injured	1,468	91	1,998	159	4,112	8,464	16,133
Truck-tractor, 1 trailer	No injury	91	32	1,255	132	431	376	2,185
	Possible injury	2,906	172	3,380	211	6,903	15,803	29,165
	Non incapacitating	5,285	234	3,975	229	13,615	41,834	64,943
	Incapacitating	15,467	370	4,803	233	29,481	142,888	193,008
	Fatal injury	16,876	1,355	12,123	569	850,481	2,143,403	3,024,238
	Unknown severity	6,119	137	2,481	170	12,098	46,002	66,837
	Unknown if injured	1,034	72	1,832	153	2,412	6,285	11,636
Truck-tractor, 2 or 3 trailers	No injury	97	33	1,267	132	443	391	2,232
	Possible injury	2,926	173	3,382	211	6,981	15,639	29,100
	Non incapacitating	5,283	234	3,968	228	13,622	42,920	66,027
	Incapacitating	15,257	370	4,805	233	30,473	144,337	195,243
	Fatal injury	16,748	1,355	12,123	569	807,958	2,033,696	2,871,880
	Unknown severity	333	35	1,277	132	828	1,645	4,118
	Unknown if injured	1,041	74	1,861	154	2,477	6,246	11,699
Truck-tractor, with unknown # of trailers	No injury	90	32	1,253	131	417	364	2,156
	Possible injury	2,967	172	3,376	211	7,498	16,171	30,185
	Non incapacitating	5,478	237	4,007	230	12,201	40,381	62,304
	Incapacitating	16,060	361	4,727	234	32,424	130,854	184,427
	Fatal injury	16,850	1,355	12,123	569	777,278	1,864,977	2,672,584
	Unknown if injured	1,000	65	1,721	149	2,171	6,460	11,417
Medium/heavy truck, unknown if with trailer	No injury	76	30	1,225	130	393	316	2,041
	Possible injury	2,822	171	3,392	211	6,467	15,618	28,470
	Non incapacitating	4,782	226	3,935	228	12,332	37,534	58,810
	Incapacitating	14,788	365	4,774	232	29,653	149,144	198,725
	Fatal injury	17,833	1,355	12,123	569	555,799	1,822,465	2,409,575
	Unknown severity	3,063	71	1,597	140	7,187	22,679	34,598
	Unknown if injured	1,015	68	1,764	150	2,294	6,486	11,627
All large trucks	No injury	85	32	1,262	132	423	335	2,137
	Possible injury	2,246	146	3,039	198	5,343	12,048	22,822
	Non incapacitating	4,804	230	3,912	227	12,608	37,012	58,566
	Incapacitating	22,977	382	4,866	233	35,390	180,352	243,967
	Fatal injury	16,889	1,355	12,123	569	821,329	2,100,377	2,952,073
	Unknown severity	4,177	133	2,658	180	8,232	29,374	44,574
	Unknown if injured	1,154	77	1,871	154	2,849	6,879	12,830
Bus, transit/intercity	No injury	14	23	1,100	126	223	34	1,394
	Possible injury	2,440	168	3,600	219	5,613	13,818	25,639
	Non incapacitating	5,807	251	4,108	221	16,876	58,175	85,217
	Incapacitating	10,275	298	4,503	231	21,495	103,396	139,968
	Fatal injury	22,642	1,355	12,123	569	792,728	2,074,193	2,903,041
	Unknown severity	1,328	161	3,603	222	4,119	6,215	15,425
	Unknown if injured	1,113	77	1,958	158	2,378	6,212	11,739

Note: Travel delay costs form Miller, Viner, et al.

TABLE 10-A. Costs per Crash by Truck/Bus Type and Crash Severity (in 1999 dollars)

TRUKTYPE	Maximum severity in crash	Medical cost	Emergency services	Property damage	Lost productivity from delays	Total lost productivity	Monetized QALYs	Total
Straight truck, no trailer	No injury	160	74	2,911	304	914	571	4,630
	Possible injury	1,648	189	5,255	440	4,329	8,122	19,543
	Non incapacitating	5,276	338	6,808	477	14,422	36,904	63,748
	Incapacitating	44,643	611	9,051	531	58,781	302,291	415,376
	Fatal injury	35,371	1,772	18,087	935	865,302	2,352,174	3,272,706
	Unknown severity	2,540	213	5,457	433	5,772	12,982	26,964
	Unknown if injured	1,673	133	3,541	319	4,763	9,271	19,381
Straight truck with trailer	No injury	206	73	2,855	299	977	863	4,974
	Possible injury	3,717	263	6,167	651	27,292	19,601	57,040
	Non incapacitating	6,433	333	6,641	469	8,904	50,336	72,647
	Incapacitating	19,593	548	8,858	459	17,007	179,748	225,754
	Fatal injury	25,677	1,731	17,933	939	866,319	2,261,505	3,173,165
	Unknown severity	15,375	348	7,892	651	27,292	113,546	164,453
	Unknown if injured	1,203	114	3,398	315	2,967	6,955	14,637
Straight truck, unknown if with trailer	No injury	146	60	2,441	261	790	626	4,062
	Possible injury	2,109	154	3,891	320	4,977	11,120	22,251
	Non incapacitating	6,654	364	7,589	545	18,600	55,252	88,458
	Incapacitating	14,282	387	6,071	361	35,223	138,716	194,680
	Fatal injury	24,118	1,542	16,236	862	617,994	1,709,226	2,369,116
	Unknown if injured	3,741	278	6,980	582	8,631	23,999	43,629
Bobtail	No injury	155	72	2,817	295	882	549	4,475
	Possible injury	1,509	176	4,930	417	4,046	7,376	18,037
	Non incapacitating	5,604	364	7,362	520	15,896	40,039	69,265
	Incapacitating	45,630	577	8,543	502	60,956	319,826	435,533
	Fatal injury	36,033	1,761	17,849	919	920,407	2,420,455	3,396,504
	Unknown severity	1,825	162	4,150	325	3,872	9,335	19,343
	Unknown if injured	1,540	127	3,513	322	4,367	8,728	18,275
Truck-tractor, 1 trailer	No injury	191	68	2,660	279	907	788	4,613
	Possible injury	3,810	262	6,010	450	9,317	20,489	39,888
	Non incapacitating	6,761	341	6,683	455	17,470	51,444	82,699
	Incapacitating	19,360	525	7,992	473	37,977	176,511	242,366
	Fatal injury	26,308	1,761	18,057	938	914,159	2,365,564	3,325,849
	Unknown severity	7,444	184	3,879	310	14,306	54,492	80,305
	Unknown if injured	1,186	118	3,557	332	3,057	6,929	14,846
Truck-tractor, 2 or 3 trailers	No injury	183	62	2,399	250	839	735	4,217
	Possible injury	3,796	262	6,040	454	9,351	20,066	39,515
	Non incapacitating	7,083	362	7,163	491	18,096	54,166	86,870
	Incapacitating	18,472	525	8,129	486	38,059	171,808	236,991
	Fatal injury	25,751	1,764	18,091	940	992,703	2,462,275	3,500,585
	Unknown severity	504	44	1,447	143	1,174	2,491	5,660
	Unknown if injured	1,108	107	3,199	297	2,874	6,414	13,702
Truck-tractor, with unknown # of trailers	No injury	209	74	2,908	305	953	817	4,961
	Possible injury	3,172	203	4,479	324	8,195	17,583	33,632
	Non incapacitating	7,421	382	7,681	534	17,093	51,591	84,167
	Incapacitating	15,383	403	6,795	462	33,551	131,674	187,807
	Fatal injury	24,588	1,689	17,640	933	899,618	2,260,946	3,204,481
	Unknown if injured	1,123	106	3,275	309	2,722	6,933	14,158
Medium/heavy truck, unknown if with trailer	No injury	142	59	2,381	254	741	574	3,896
	Possible injury	4,506	303	6,805	494	10,433	24,865	46,911
	Non incapacitating	6,541	351	7,070	487	16,905	48,953	79,820
	Incapacitating	31,317	853	12,130	643	65,294	313,119	422,713
	Fatal injury	25,946	1,703	17,704	929	869,923	2,291,273	3,206,548
	Unknown severity	9,424	345	9,695	922	22,739	68,285	110,487
	Unknown if injured	1,197	111	3,399	320	2,979	7,402	15,088
All large trucks	No injury	182	70	2,764	290	915	718	4,649
	Possible injury	3,051	237	5,778	449	7,564	16,124	32,755
	Non incapacitating	6,285	344	6,813	469	16,553	46,694	76,689
	Incapacitating	28,685	560	8,454	499	45,978	224,204	307,881
	Fatal injury	28,429	1,757	17,975	934	927,194	2,401,793	3,377,148
	Unknown severity	5,357	199	4,669	374	10,610	36,814	57,648
	Unknown if injured	1,326	121	3,525	326	3,527	7,630	16,129
Bus, transit/intercity	No injury	36	60	2,800	319	570	91	3,556
	Possible injury	4,547	345	8,404	612	10,944	26,131	50,371
	Non incapacitating	10,039	528	10,790	732	28,138	91,357	140,852
	Incapacitating	17,331	672	12,467	779	37,863	161,980	230,312
	Fatal injury	29,936	2,075	24,574	1,320	886,908	2,342,427	3,285,920
	Unknown severity	4,303	555	13,442	932	13,079	19,499	50,878
	Unknown if injured	1,216	121	3,982	391	2,969	7,170	15,457

Note: Travel delay costs form Miller, Viner, et al

TABLE 11-A. Costs per Crash by Truck/Bus Type (in 1999 dollars)

Truck/bus type	Medical costs	Emergency services	Property damage	Lost productivity from delays	Total lost productivity	Monetized QALYs	Total
Straight truck, no trailer	3,139	150	3,959	352	11,213	34,973	53,435
Straight truck with trailer	2,217	152	3,933	348	13,783	38,889	58,974
Straight truck, unknown if with trailer	1,448	117	3,535	333	3,753	10,741	19,594
Bobtail	3,341	148	3,843	342	14,402	42,200	63,934
Truck-tractor, 1 trailer	2,525	160	3,868	333	18,143	49,568	74,265
Truck-tractor, 2 or 3 trailers	2,754	178	3,947	326	27,409	72,437	106,725
Truck-tractor, with unknown # of trailers	1,527	121	3,414	321	12,267	30,784	48,112
Medium/heavy truck, unknown if with trailer	1,819	128	3,515	315	5,339	16,699	27,501
All large trucks	2,769	156	3,913	341	15,108	43,039	64,985
Bus, transit/intercity	2,270	174	4,844	426	8,489	24,267	40,045

Note: Travel delay costs form Miller, Viner, et al

TABLE 12-A. Costs per Injury Crash by Truck/Bus Type

Truck/bus type	Medical costs	Emergency services	Property damage	Lost productivity from delays	Total lost productivity	Monetized QALYs	Total
Straight truck, no trailer	9,746	315	6,212	454	34,039	111,394	161,707
Straight truck with trailer	6,816	332	6,383	459	43,132	126,080	182,744
Straight truck, unknown if with trailer	4,977	272	6,503	530	11,815	38,191	61,757
Bobtail	11,111	334	6,321	456	47,385	143,876	209,028
Truck-tractor, 1 trailer	7,626	360	6,502	450	55,834	156,268	226,591
Truck-tractor, 2 or 3 trailers	7,797	405	6,980	474	79,553	213,148	307,883
Truck-tractor, with unknown # of trailers	4,133	213	4,408	351	34,642	90,072	133,469
Medium/heavy truck, unknown if with trailer	4,105	222	5,045	396	11,591	38,699	59,662
All large trucks	8,448	343	6,409	453	46,284	136,066	197,550
Bus, transit/intercity	6,241	378	8,481	615	22,559	67,218	104,877

Note: Travel delay costs form Miller, Viner, et al

TABLE 13-A. Total Crash Costs by Truck/Bus Type: 1997 (in 1999 dollars)

Truck/bus type	Medical costs	Emergency services	Property damage	Lost productivity from delays	Total lost productivity	Monetized QALYs	Total
Straight truck, no trailer	410,925,609	21,925,212	605,615,580	45,106,581	1,438,963,528	4,097,371,035	6,574,800,964
Straight truck with trailer	48,903,125	2,912,334	70,427,328	4,295,535	170,077,016	815,743,198	1,108,063,001
Straight truck, unknown if with trailer	-	-	-	-	-	-	-
Bobtail	19,668,249	1,367,907	40,435,116	6,736,052	283,773,001	126,436,920	471,681,193
Truck-tractor, 1 trailer	436,023,967	29,575,165	763,765,923	56,485,046	3,079,087,566	7,271,946,362	11,580,398,982
Truck-tractor, 2 or 3 trailers	19,805,517	1,301,041	25,671,809	1,536,699	129,297,584	779,751,440	955,827,391
Truck-tractor, with unknown # of trailers	1,644,565	150,998	4,657,117	387,664	14,825,473	10,308,955	31,587,108
Medium/heavy truck, unknown if with trailer	3,665,223	314,045	9,387,909	1,503,533	25,512,841	25,075,241	63,955,259
All large trucks	940,636,254	57,546,702	1,519,960,782	116,297,253	5,150,951,716	13,126,633,151	20,795,728,605
Bus, transit/intercity	36,167,501	3,228,524	93,226,729	10,290,559	205,041,915	412,292,371	749,957,039

Note: Travel delay costs form Miller, Viner, et al.