



Comparing the fatality risks in United States transportation across modes and over time

Ian Savage

Department of Economics and the Transportation Center, Northwestern University, 2001 Sheridan Road, Evanston, IL 60208, USA

ARTICLE INFO

Article history:
Available online 21 January 2013

JEL Codes:
R41

Keywords:
Safety
Transportation
United States

ABSTRACT

This paper analyzes the transportation fatality risk in the United States. The analysis is in two parts. The first part compares the relative risks of the different modes based on data for the decade from 2000 to 2009. The second part is a time-series analysis for each mode using annual data from 1975 to 2010. By almost any measure, transportation is considerably safer now than it was in the mid 1970s. The improvement is especially noticeable for commercial modes such as aviation, railroads and maritime. Even the risks from private highway driving have halved during the past thirty-five years.

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This paper analyzes the transportation fatality risk in the United States. The analysis is in two parts. The first part compares the relative risks of the different modes based on data for the decade from 2000 to 2009. Using data from an entire decade minimizes any misleading comparisons that might result from using data for a single year. This is because for some modes there are extreme fluctuations in annual fatality counts due to rare catastrophes that can claim tens, and sometimes hundreds, of lives. The second part is a time-series analysis for each mode using annual data from 1975 to 2010. The choice of 1975 as the starting point was primarily determined by data availability. The federal government established a number of transportation safety agencies in the late 1960s and early 1970s and this resulted in an expansion of data collection.

The focus on fatalities is primarily motivated by a greater confidence that this measure of safety is reported more consistently and accurately across modes and time. In general, cross-sectional and time-series comparisons in fatalities are also indicative of differences in non-fatal injuries, illnesses, and property damage. Albeit that the correlation is not perfect. In particular, fatalities are a poor measure of some of the environmental risks associated with the transportation of oil products and hazardous materials. In addition many of the advances in safety in recent decades have focused on “crashworthiness” whereby design changes have been made to increase the survivability of crashes and mitigate the severity of injuries. Consequently it is possible that a reduction in fatalities may be partly compensated for by an increase in the number of injuries.

E-mail address: ipsavage@northwestern.edu.

Often fatality data is problematic for analytical purposes because fatalities are generally few in numbers, and in some modes occur in very rare multi-fatality events. As a consequence there are often considerable year-to-year fluctuations, and analyses comparing different modes or time periods suffer from large standard errors and poor statistical significance. However, the United States is a large country with an average population in the decade from 2000 to 2009 of 295 million. Therefore, while the risks are low, the annual count of fatalities is substantial in most modes. While passenger fatalities in scheduled aviation, passenger rail, ferryboat and bus modes are dominated by rare catastrophes, other classes of fatalities within these modes are characterized by many single-fatality events that are more consistent in number from year to year. Examples include fatalities resulting from on-demand air taxis, private flying, private boating, collisions between trains and vehicles at rail-highway grade crossings and between trains and pedestrians who are trespassing on the tracks.

1. Cross-sectional analysis

The analysis in this section is based on calculating an average annual number of fatalities using data for the ten-year period from 2000 to 2009. An [Appendix A](#) gives details on the sources of the data.

1.1. An overview

In an average year between 2000 and 2009, 43,239 people died in transportation incidents. This is an annual risk of 1 in 6800 based

on the number of U.S. residents (of course, some U.S. residents die in transportation incidents elsewhere in the world, and some foreign residents die in incidents within the United States).

Transportation risks accounted for about 1.78% of the 2.43 million annual deaths from all causes in the United States. This amounted to 1 in every 56 deaths. However, among “unintentional injury deaths” – those deaths not caused by aging, disease, suicide and homicide – transportation incidents were the most prevalent cause of death. Transportation-related fatalities represented 38% of all “unintentional injury deaths.” Moreover, they were equivalent in number to the sum of the next two most prevalent causes, which were falls and poisonings.

One might argue that transportation equipment, and in particular the motor vehicle, must be the most dangerous machines that we interact with on a daily basis. The annual toll in motor vehicle crashes exceeds the deaths resulting from the next most dangerous mechanical device, firearms, by about 40% (based on data from 2000 to 2007, with total firearms deaths calculated from a combination of homicides, suicides, law enforcement acts and accidental discharges).

A categorization of the 43,239 fatalities by mode and type of user is shown in Table 1. Users are divided to two broad categories. The first is private transportation that encompasses walking, bicycles, motorcycles, cars and light trucks, recreational boating and private flying. Here the user is in control of their vehicle, or is a passenger in such a private vehicle. The other broad category is commercial transportation where passengers or freight shippers contract with transportation providers. Victims in the commercial category can be either users (primarily passengers), employees of transportation companies, or bystanders who are fatally injured by debris or hazardous materials releases. There is also an intersection of the two categories when there is a collision between a private user and a commercial carrier.

Fig. 1 provides a diagrammatic presentation of the magnitude of the various categories. Incidents that solely involved private users accounted for the vast majority (85.2%) of total transportation fatalities. Some of these incidents are single-vehicle crashes and others are when multiple private users collide with each other. About 1 out of every 7 (14.8%) transportation fatalities occurred in

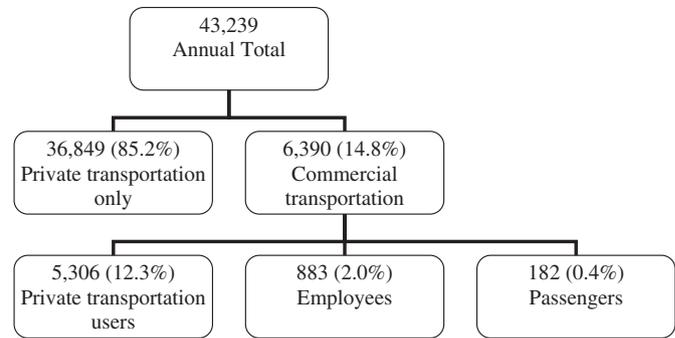


Fig. 1. Categorization of average annual fatalities 2000–2009.

incidents involving commercial transportation. The vast majority, 83%, of the victims of commercial transportation-related incidents were actually private users who were in collision with a commercial carrier. Collisions between private highway users and trucks, taxis and buses resulted in an average loss of 4467 private user lives each year. In addition, 247 motorized private users, and 68 pedestrians, died each year in collisions with trains at rail-highway grade crossings. A further 524 pedestrians died each year as a result of trespassing on train tracks at locations away from formal crossings.

Consequently only 2.5% of the total fatalities were people directly involved in the production or consumption of commercial transportation services as an employee or passenger. The implication for economists is that two extensive field of safety research – industrial organization analysis of firms’ commercial safety choices and labor economics’ examination of workplace safety – bear on only a small minority of total fatalities.

1.2. Highways

We now turn to look at individual modes, and start by analyzing the highway sector. Nearly all of the total fatality risk occurs in this sector. Deaths on the highway were 94.4% of the national total. If highway deaths that occurred in collisions at rail-highway grade crossings were included the total would be even higher at 95.2%.

Table 1 Average annual fatalities in the United States 2000–2009.

	Private transportation			Commercial transportation		
	Crashes solely involving private users	Crashes with commercial highway carriers	Crashes with commercial non-highway carriers	Passengers	Employees	Bystanders
<i>Highway Modes</i>						
Cars and light trucks	26,678	3766	245 ^a	7 ^b	9 ^b	n.a
Pedestrians & bicycles	4930	545	592 ^c	n.a	n.a	n.a
Motorcycles	3989	156	2 ^a	n.a	n.a	n.a
Large Trucks	n.a	n.a	n.a	n.a	724	n.a
Buses	n.a	n.a	n.a	30	9	n.a
<i>Non-highway modes</i>						
Maritime	704	0	1	42	85	1
Aviation ^d	548	0	1	74	21	2
Railroads	n.a	n.a	n.a	7	27	4
Rail Transit	n.a	n.a	n.a	22	3	0
Pipeline	n.a	n.a	n.a	n.a	5	12
<i>Totals</i>						
Total	36,849	4467	839	182	883	19
U.S. Total	43,239					

Notes: n.a. = not applicable.

^a collisions with trains and rail transit vehicles at highway-rail grade crossings.

^b taxi and limousine occupants.

^c 11% result from collisions with trains and rail transit vehicles at highway-rail grade crossings. 89% are pedestrian trespassers elsewhere on the railroad. These data exclude suicides. Suicides on rail transit lines averaged 22 a year. During this time period suicidal acts on mainline railroads were not reportable. It is suspected that there are 220–245 unreported annual suicides on mainline railroads.

^d aviation deaths exclude those caused by suicide, sabotage and terrorism. Sources: See Appendix A.

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