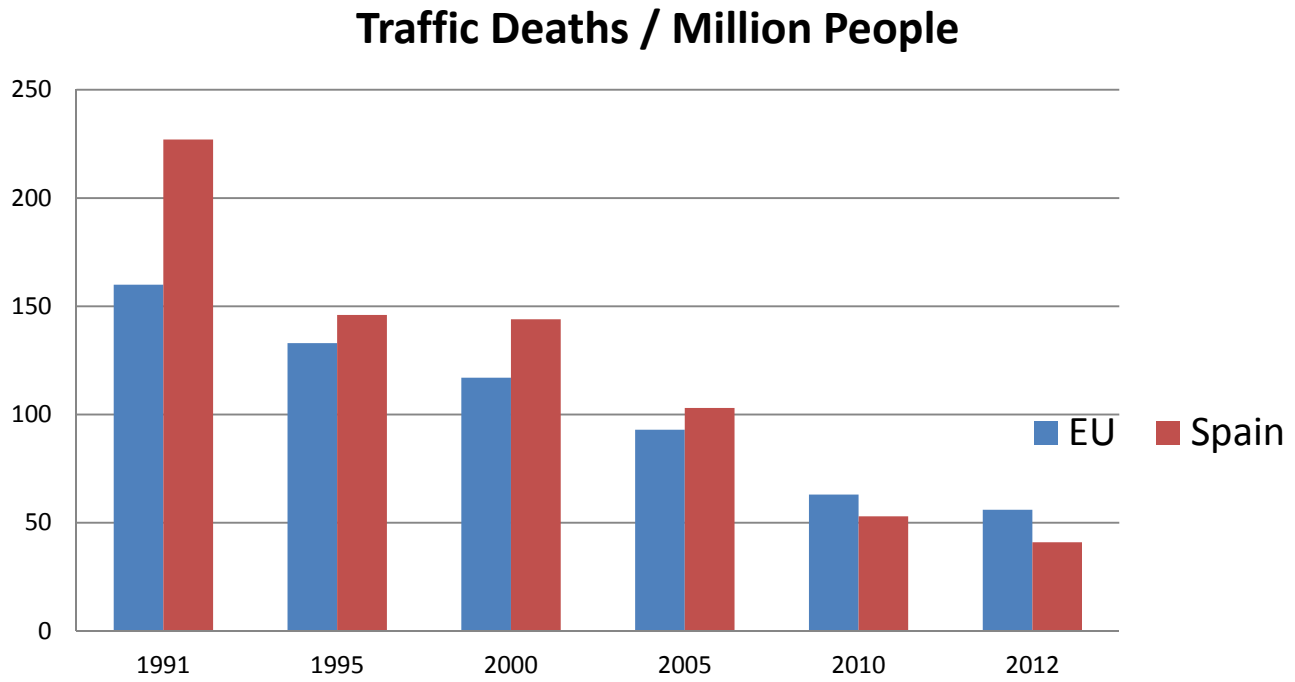
Topic 2: Economics of Traffic Safety

Traffic Safety Signs – Just for Fun

Traffic Fatalities Are Decreasing



Reasons Cited in the Literature

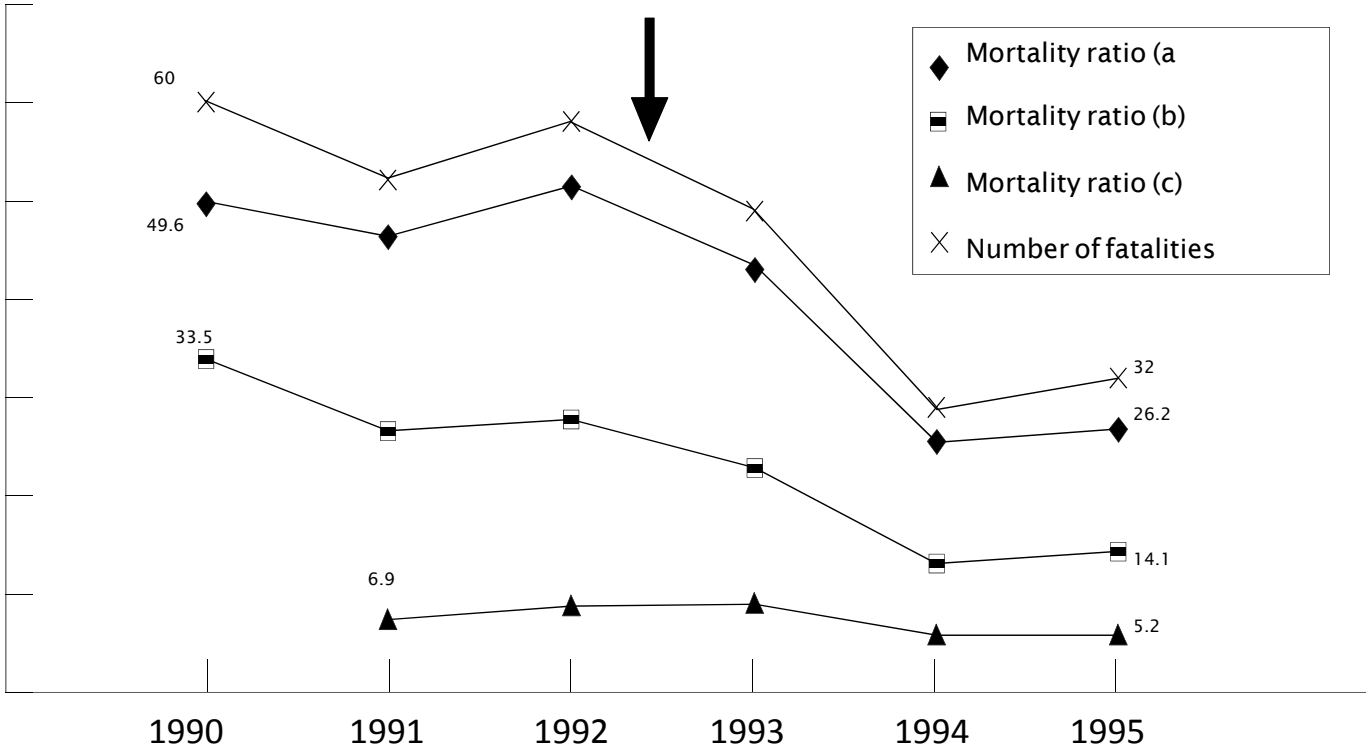
- Automobiles are safer (seat belts, airbags, electronic sensors)
- Roads are safer (more limited-access roads, fewer level crossings)
- Drivers are safer (better education, higher minimum driving age)
- Better enforcement of traffic laws
- Public interventions (stricter DUI* laws, helmet laws for 2-wheeled motor vehicles)

*Conducción bajo la influencia del alcohol

Spain's Helmet Law

- Federal road safety law required use of helmets by all 2-wheel motor vehicle (MV) drivers and passengers
- Extended to urban areas in 1992
- Arguments
  - Pro: Helmets reduce the severity of injury and the probability of death
  - Con: People compensate by taking more risks when they wear helmets
- Josep Ferrando compared deaths of 2-wheel MV occupants in Barcelona before and after the law took effect ("pretest-posttest" design)

Ferrando's Results



Mortality trends among two wheel vehicle users, Barcelona, 1990–95. Mortality Ratio: (a) = x 10^7 vehicle km; (b) = x 10^5 two wheel vehicles; (C) = x 10^3 two wheel crashes.

Josep Ferrando, et al., "Impact of a Helmet Law on Two Wheel Motor Vehicle Crash Mortality in a Southern European Urban Area," Injury Prevention, 6 (2000), 184-188

Comments on Ferrando

- What is lacking from this study?
- How can the design be made stronger?

Cohen and Einav's Study of Seat Belt Laws

- Alma Cohen and Liran Einav studied the effect of automobile seat belt laws in the U.S.
- States have a great deal of autonomy in the U.S. federal system
- During the observation period, from 1983 to 1997, 49 of 50 states adopted seat belt laws
  - The late-adopting states are a control group for early adopters
- Outcomes are traffic deaths among car occupants and deaths among non-occupants (pedestrians and 2-wheel MVs)
  - Laws affect car occupants *directly* and *indirectly* through the compensating effect
  - Changes in non-occupant deaths are due only to the compensating effect

Cohen and Einav's Empirical Model

$$Y_{st} = \beta_0 + \beta_1 USE_{st} + \beta_2 X_{st} + \beta_3 STATE_s + \beta_4 YEAR_t + u_{st}$$

Y = traffic fatalities in state s in year t
USE = seat belt use in state s in year t
X = time-varying characteristics of state s in year t
STATE = fixed effects for states
YEAR = fixed effects for years
u = error term for state s in year t

The Endogeneity Problem

- Seat belt use might be correlated with unmeasured features of states that change over time
- Would bias the effect of seat belt use, making the estimate of β_1 too large or too small
- They 'instrument' for seat belt use with the mandatory seat belt law
  - It's still possible that states passed laws because they faced in increase in traffic fatalities
  - But all states eventually passed laws
  - Passing a seat belt law usually took several years of debate and is not likely to be correlated with the error term in the traffic fatality equation

Cohen & Einav's Results

OUTCOME	KEY VARIABLE	COEFFICIENT
OCCUPANT FATALITIES PER VEHICLE MILE	SEAT BELT USE	-.0052
LN OCCUPANT FATALITIES PER VEHICLE MILE	LN SEAT BELT USE	-.133
NON-OCCUPANT FATALITIES PER VEHICLE MILE	SEAT BELT USE	NO EFFECT
LN NON-OCCUPANT FATALITIES PER VEHICLE MILE	LN SEAT BELT USE	NO EFFECT

- Seat belt use reduced occupant fatalities with no indication of a compensating effect
- Focusing on the logarithmic equation, a one-percent increase in seat belt use reduces occupant fatalities by .13%

Alma Cohen and Liran Einav, "The Effects of Mandatory Seat Belt Laws on Driving Behavior and Traffic Fatalities," Review of Economics and Statistics, 85:4 (November, 2003), 828-843

Blood Alcohol Content (BAC) Laws

- Blood Alcohol Content (BAC), measured in grams per deciliter (g/dl), is an objective indicator of DUI
- Spain: Surpassing the limit of 0.05% carries a €500 fine. Driving with BAC > 0.12% is a crime with up to 6 months imprisonment and license suspension up to 4 years.
- In the U.S., states could set their own limits until 2004, when 0.08% became the national standard
  - Corresponds to 5 bottles of beer in 2 hours for average man and 3 for average woman
  - Prior to 2004, many states passed laws that reduced the threshold BAC to 0.08%

Thomas Dee's Article

- Presents evidence on how states' 0.08 BAC laws affected traffic fatalities
- Prior studies found mixed evidence
- Dee's work improves on past studies in several ways:
  - Data from 1982-1998 include "before and after" periods for 14 states that changed their laws
  - The study controls for observed influences on traffic fatalities as well as state and time effects

Thomas S. Dee, "Does Setting Limits Save Lives? The Case of 0.08 BAC Laws," Journal of Policy Analysis and Management, 20:1 (2001), 111-128

“Difference-in-Differences” Analysis

- Dee used the same method as did Cohen and Einav
  - Known as ‘difference-in-differences’ analysis
  - Also known as ‘pretest-posttest with untreated control group’
- Compare Δoutcome in the treated group with Δoutcome in the untreated control group
- Effect of Treatment = Δoutcome treated – Δoutcome control
- Very common design in observational research

Dee's Results

Variable	Coefficient	SE
0.08 BAC law	-0.072	0.028
0.10 BAC law	-0.053	0.020

Control group = states with no BAC law

Note: in a semi-logarithmic equation, the percentage change in the dependent variable with respect to a 1-unit change in LAW is approximately equal to exp(coefficient). Therefore, states with 0.08 BAC laws have about 7% fewer traffic fatalities than states with no law. Can you do the math for a .10 BAC law?

Interpretation

- 0.10 BAC laws reduce traffic fatalities by 5.2% and 0.08 laws contribute another 1.8% reduction
- On the basis of 41,471 traffic deaths in 1998 in the U.S., the marginal contribution of a national 0.08 BAC law would have been 746 lives saved
- The value of saving a life is between $3 – $7 million with a midpoint of $5 million
- The annual savings from a national 0.08 BAC law would have been $3.73 billion

The Value of a Life

- Perfect traffic safety is not possible at any price
- But society needs to decide how much it's worth to make driving (and many other things) safer
- Workers' willingness to accept risk for higher wages is one method to place a value on lifesaving
  - Suppose jobs with .001 excess death rate pay €3 per hour more than safe jobs
  - The value of lifesaving is €3 x 1500 hours of work per year x 1,000 = €3 million
  - This is the value of a *statistical* life, which is appropriate for most projects that improve traffic safety

Richard Thaler and Sherwin Rosen, "The Value of Saving a Life: Evidence from the Labor Market," in Household Production and Consumption, ed. by N.E. Terleckyj, 1975

“3D” Analysis

- Most alcohol-related traffic fatalities occur at night or on the weekend
- Therefore, the effect of a 0.08 BAC law should be greater during those periods
- This is called ‘difference-in-difference-in differences’ or ‘3D’ analysis
- Dee compared the effect of a 0.08 BAC law on fatal crashes at night or weekend vs. other times vs. no law
- Results of this test were mixed:
  - Weekend vs. weekday effect = -0.028
  - Night and day effects were not significantly different

Dee Might Have Done More

- Studies show that people *anticipate* new laws
  - Behavior changes between the time the law is passed and when it becomes effective
- *Enforcement* of the law may also change over time after it has gone into effect
  - Enforcement may become more or less strict
- Dee could have tested for these anticipation and enforcement effects

Dram Shop Laws

- Servers of alcohol may be held accountable for injuries stemming from accidents caused by an obviously intoxicated adult patron or a minor patron
- Not all drinkers abuse alcohol, but 40-63% of drivers arrested for drunken driving consume their alcohol in bars or restaurants
  - Dram shop liability will increase the price of drinking in bars
  - The cost of abusive drinking will increase relative to the cost of non-abusive drinking
- Economic theory predicts that server liability will have a large effect
  - There are few servers and many bar patrons
  - Servers can change their behavior to reduce the risk that patrons get drunk

Sloan's Study

- Sloan, et al., analyzed the Behavioral Risk Factor Surveillance Survey (BRFSS) for (a) drinking at all, (b) binge drinking, and (c) drink and drive
- 49% of U.S. adults drink, 26% of drinkers "binge" (5+ drinks on one occasion in past month) and 5% drink and drive
- Explanatory variables in their model included personal characteristics, price, and state legal standards

Frank Sloan, et al., Drinkers, Drivers, and Bartenders, 2000

Results for Dram Shop Law

Probability of Behavior	Coefficient	P-Value
Any alcohol consumption	-0.11	<.01
Binging, conditional on drinking	-0.013	Not Significant
Drink and drive	-0.039	<.05
Adult Motor Vehicle Fatality Rates*		
Total	-0.40	<.01
Alcohol-related	-0.31	<.05
Single car at night	-0.24	<.01

*similar findings for motor vehicle fatality rates for minors