The Economics of Long Work Hours: Using Incentives to Change Behavior

Keynote 2

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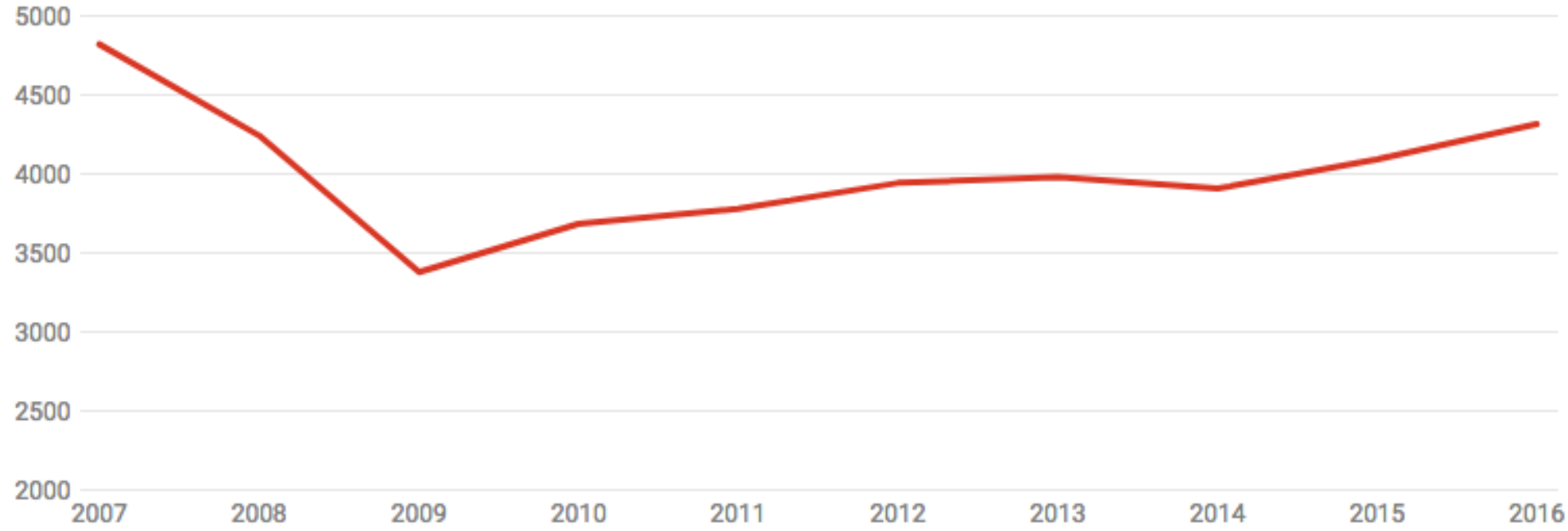
Truck Fatalities Rising

Deaths from truck crashes in the US

In 2016 there were 4,317 total fatalities from large truck crashes in the US.



A large truck is defined as a truck with a gross vehicle weight rating greater than 10,000 pounds. The "All vehicle types" category includes crashes involving passenger cars, light trucks, buses, motorcycles, or any other type of motorized vehicle.

Chart: The Conversation, CC-BY-ND • Source: U.S. Federal Motor Carrier Safety Administration • Get the data

Fatal truck-involved crashes are increasing:

- 40% between 2009 and 2017
- 45% per VMT between 2009 & 2017
- 8% in last year (2016 to 2017)

Why use economics to understand safety and health?

- "The Human Cost of Amazon's Fast, Free Shipping"
  - *NY Times* September 5, 2019
  - https://www.nytimes.com/2019/09/05/us/amazon-delivery-drivers-accidents.html
- "How Amazon hooked America on fast delivery while avoiding responsibility for crashes"
  - *ProPublica's* Big Story September 5, 2019
  - https://features.propublica.org/amazon-delivery-crashes/how-amazon-hooked-america-on-fast-delivery-while-avoiding-responsibility-for-crashes/
- "The Cost of Next-Day Delivery"
  - *BuzzFeed* August 31, 2019
  - https://www.buzzfeednews.com/article/carolineodonovan/amazon-next-day-delivery-deaths

Work Stress and Crashes

- The stresses associated with work as a CMV driver put them at significant health and safety risk
  - Irregular schedules
  - Economic pressures
  - Exceedingly long work hours
- Stresses associated with “Just In Time” logistics
  - Pressure for scheduled delivery
  - Pressure for rapid delivery
  - Pressure to cut cost
- Amazon stories identify all of these stressors
  - Long, irregular, and stressful work hours lead to fatigue
  - Fatigue leads to crashes and chronic illness.

Vulnerable Workers, Vulnerable Public

- Part time, on-demand work completely controlled by cargo owner, which is Amazon
- Amazon subcontracts most of its delivery business
  - Amazon deflects liability for all crashes
  - Amazon deflects liability for all injury and death

- Economists call these costs “externalities”
  - External costs paid by society
  - External to the market (cost not captured in the price)
  - Cost not captured by price of service is economically inefficient

What are these costs?

- Fatigue
- Stress-related illness
- Stress-related driver injury
- Crash costs
- Damaged market, unpaid taxes, under-insured vehicles and drivers, reckless disregard for public

Workplace Safety and Health Requires Economic Analysis

- **Competition drives carriers to lowest price**
- Lowest price drives carriers to lowest cost
- Lowest cost drives rates down and squeezes drivers
  - Unqualified, dangerous drivers
  - Dangerous workplace pressure
  - Dangerous hours of work
- **Carriers outsource to smaller carriers and individual contractors**
  - Subcontracting cuts employment cost while adding layers of overhead
    - Workers' compensation
    - Employment taxes (like Social Security and Medicare)
    - Training, including safety training
  - Eliminate risk that drivers engage in "protected concerted activity"
    - Including but not limited to unionization
  - Eliminate liability for safety risk
    - Liability pushed down to contractor
- Not just in trucking (Continental Express crash is airline example)

WHY DOES TRUCK DRIVING INVOLVE LONG WORKING HOURS?

SOURCES

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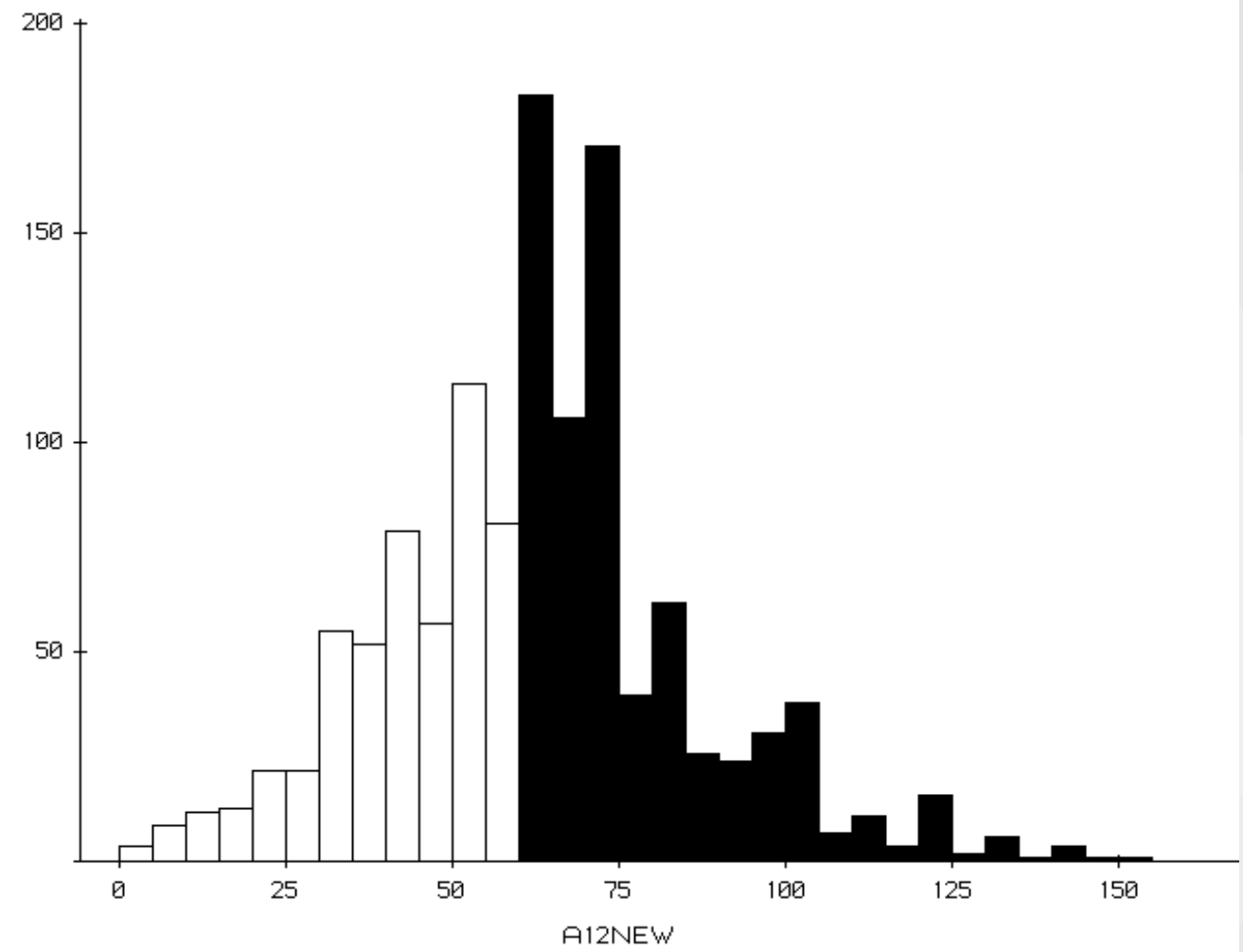
FACT: Truckers Work Long Hours

- UMTIP 1997 survey showed median non-union driver worked 65 hours/week
  - 55% not paid for loading/unloading
  - 70% not paid for waiting or other on-the-job time.
- NIOSH 2010 survey shows median employee driver (almost all non-union) works 60 hrs/week
  - Employee drivers average 63 hours of work per week
- NIOSH 2010 survey also shows 20% exceed 75 hours/week
  - On average, 10.5 hours of work/week (22%) are unpaid
  - On average, 27% of employee drivers' work week is unpaid labor

- Truck drivers are not paid for all work time
- That is why surveys show long-haul drivers regularly work an impossible (illegal) number of hours.

Drivers in Black Work Excessive Hours

Number of drivers



Hours worked/week

- Median: 60 hours
- Average: 61.5 hours
- n = 1,254 long haul truck drivers

Why so many hours?

- If the regulations restrict CMV drivers to 60 hours of work per week, why do half of all long-haul drivers exceed this limit?
- How do carriers and drivers get around the rules?
- How do FMCSA regulations continue to effectively permit excessive hours?
- The answer rests in conflicting definitions of “work”.

DOL-FLSA Definition of Work

- All time during which employees work for an employer, **including waiting time**, is payable:
  - Unless employer frees the worker from work for specific time and employee knows in advance when work time starts and ends; and
  - Unless worker has practical freedom to leave the place of work to go about his/her personal activity; and
  - Unless worker is not engaged in the work for which he/she was hired, including being available for a call;
  - All time is payable if worker is located away from employer's place of work, and wait time is part of employee's regular work

DOT-FMCSA Definition of Work

- Waiting time is non-work time as long as:
  - "The driver is relieved of all duty and responsibility for the care and custody of the vehicle, its accessories, and any cargo or passengers it may be carrying."
  - "During the stop, and for the duration of the stop, the driver must be at liberty to pursue activities of his/her own choosing."
    - Example: looking at his phone or reading (circumstances limit choices)
    - Companies may interrupt driver's free time and sleep time.
    - Off duty time during a shift may have indeterminate start and end time.
- FMCSA regulations allow carriers to order drivers to log non-driving FLSA-defined work time off duty
  - Drivers have economic incentive to log unpaid work time off duty
  - Since FMCSA has no position on driver pay, grounds for definitions are quite different.
  - Results are inconsistent with policy goal to limit hours of work

Time is Money

- Economic theory predicts that workers will trade labor for leisure as their earnings increase.
- Rarely can we see this in the data but long hours in trucking allows us to observe it.
- We will test the Target Earnings Hypothesis
  - Drivers work to reach their earnings targets
  - Target earnings are enough to pay their bills
  - Drivers should reduce work time after reaching their targets

University of Michigan Trucking Industry Program Driver Survey 1997-98

- Truck stop survey of 233 employee drivers
- These employee drivers worked an average of 64.5 hours per week with a minimum of 25 and a maximum of 126
- Drivers earned an average of 28.6¢ per mile [45¢/mi in today's dollars; 5% less than today]
- Averaged 13.7 years of experience
- Average company tenure of 3.5 years

Two-stage least-squares model

- Stage 1: Estimate pay rate based on driver characteristics
- Stage 2: Estimate hours based on rate of pay

Stage 1: Estimate Pay Rates

$$Rate_i = \beta_1 + \beta_2 X_{i2} + \beta_3 X_{i3} + \ \ldots \ \ \beta_K X_{iK} + \varepsilon_i$$

- $Rate_i$ is the mileage rate for the i^{th} driver
- X's represent characteristics of the driver and job that are relevant to determining the mileage rate
- β's are the parameters to estimate
- ε summarizes the random components and unobserved characteristics of the individual driver and job.

Table 1: Mileage Rate Equation

Variable	Estimate	Standard Error	t-value
Constant	0.241***	0.016	14.918
Experience	0.002**	0.001	2.133
Experience^2	-4.1E-05	0.000029	-1.437
Tenure	0.004**	0.0017	2.049
Tenure^2	-0.00011**	0.000054	-1.972
HS Degree	0.000574	0.008	0.076
Union	0.097**	0.057	1.726
White	0.016**	0.008	1.858
Union by White	-0.04	0.058	-0.695
Previous Moving Violation	0.007	0.007	1.051
Medium Firm	0.013**	0.006	2.065
Large Firm	0.026***	0.009	3.164
Private Carriage	-0.020	0.010	-1.900
Dry van	-0.008	0.007	-1.221
Miles per Dispatch	-0.00002***	0.000006	-3.276
Unpaid Time	-0.010	0.008	-1.192
Paid Days Off	0.001**	0.0004	2.071

Sample Size	233	Dependent variable:	Mileage Rate
R-squared:	0.385	Rbar-squared:	0.340
Residual SS:	0.431	Std error of est:	0.045
F(16,216):	8.457	Probability of F:	0.000

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Stage 2: Estimate Weekly Hours

$$Hours_i = \gamma_1 + \gamma_2 * W_i + \gamma_3 W_i^2 + \gamma_4 Z_{i4} + \ldots \gamma_K Z_{iK} + \varepsilon_i$$

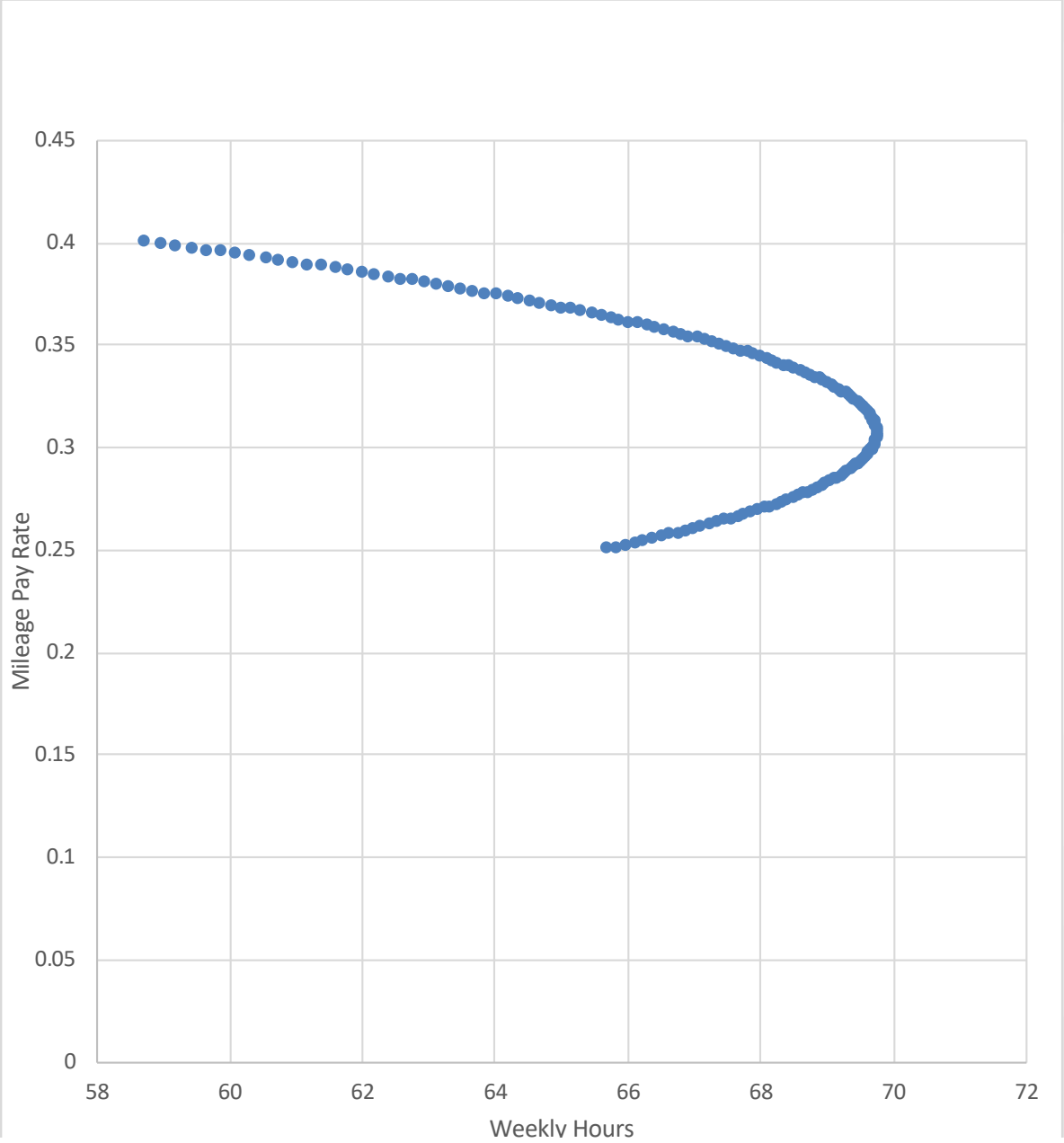
- $Hours_i$ are the weekly hours of the i^{th} driver
- W_i is the fitted wage of the i^{th} driver <u>from the wage estimation equation</u>
- Z's represent characteristics of the driver and job that influence the number of hours worked
- ε_i captures the random components of the hours worked not included in the explanatory variables

Table 2: Weekly Hours of Work Equation

Variable	Estimate	Standard Error	t-value
Constant	-116.29**	52.88	-2.199
Fitted Rate	776.75**	370.8	2.095
Fitted Rate^2	-1266.30**	637.3	-1.987
Age	3.119***	0.849	3.674
Age^2	-0.035***	0.001	-3.578
Married	-4.853*	2.548	-1.905
Other Income ($1,000)	0.021	0.067	0.348
% Night Driving	9.241	5.598	1.651
% Non-Driving Time	-21.820**	9.788	-2.229
Unpaid Time	11.066***	3.441	3.216
Union	10.842	9.372	1.157
Miles per Dispatch	0.0007	0.002	0.313
Private Carriage	-4.082	3.464	-1.178
Tenure	-0.365*	0.201	-1.820
Last Home	-0.006	0.125	-0.045

Sample Size:	233	Dependent variable:	Hours per Week
R-squared:	0.164	Rbar-squared:	0.111
Residual SS:	63611.8	Std error of est:	17.082
F (14,218):	3.061	Probability of F:	0.000

Estimated Labor Supply Curve for Long-Distance Truck Drivers



We estimate that drivers would work 60 hours at just less than 40 cents/mile in 1997 dollars.

That is 60 cents/mile in 2017 dollars.

"Safe Rates and Unpaid Labor:
Non-Driving Pay and Truck Driver Work Hours"

Kudo and Belzer, *Economic and Labour Relations Review*
(forthcoming December 2019)

- Data: NIOSH Long Haul Truck Driver Survey
- Results
  - Pay for non-driving time reduces driver work hours significantly.
  - Supports the "target earnings hypothesis".
  - Supports Belzer and Sedo's backward-bending labor supply curve.
  - Takeaway: Drivers can and will log unpaid non-driving labor off duty, allowing them to drive more hours and reach targets.
  - Drivers paid for non-driving work will reduce their work hours to a safer level – particularly if the carrier requires them to log it.

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Policy Implications

- Higher pay rates and pay for all work time will reduce drivers' incentives to work illegal hours
  - Drivers more likely will log all work time
  - This will reduce hours and improve safety
- Requiring pay for all labor time would reduce incentive to log DOL-defined work time off duty
  - Driver incentives will line up with policy objectives
  - Carriers cannot whipsaw drivers.
  - Cargo owners cannot whipsaw carriers.
  - Neither can race to the bottom for cheap labor.
  - Might make truck driving attractive again.

CAN YOU PAY FOR SAFETY? DOES SAFETY PAY?

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A Case Study

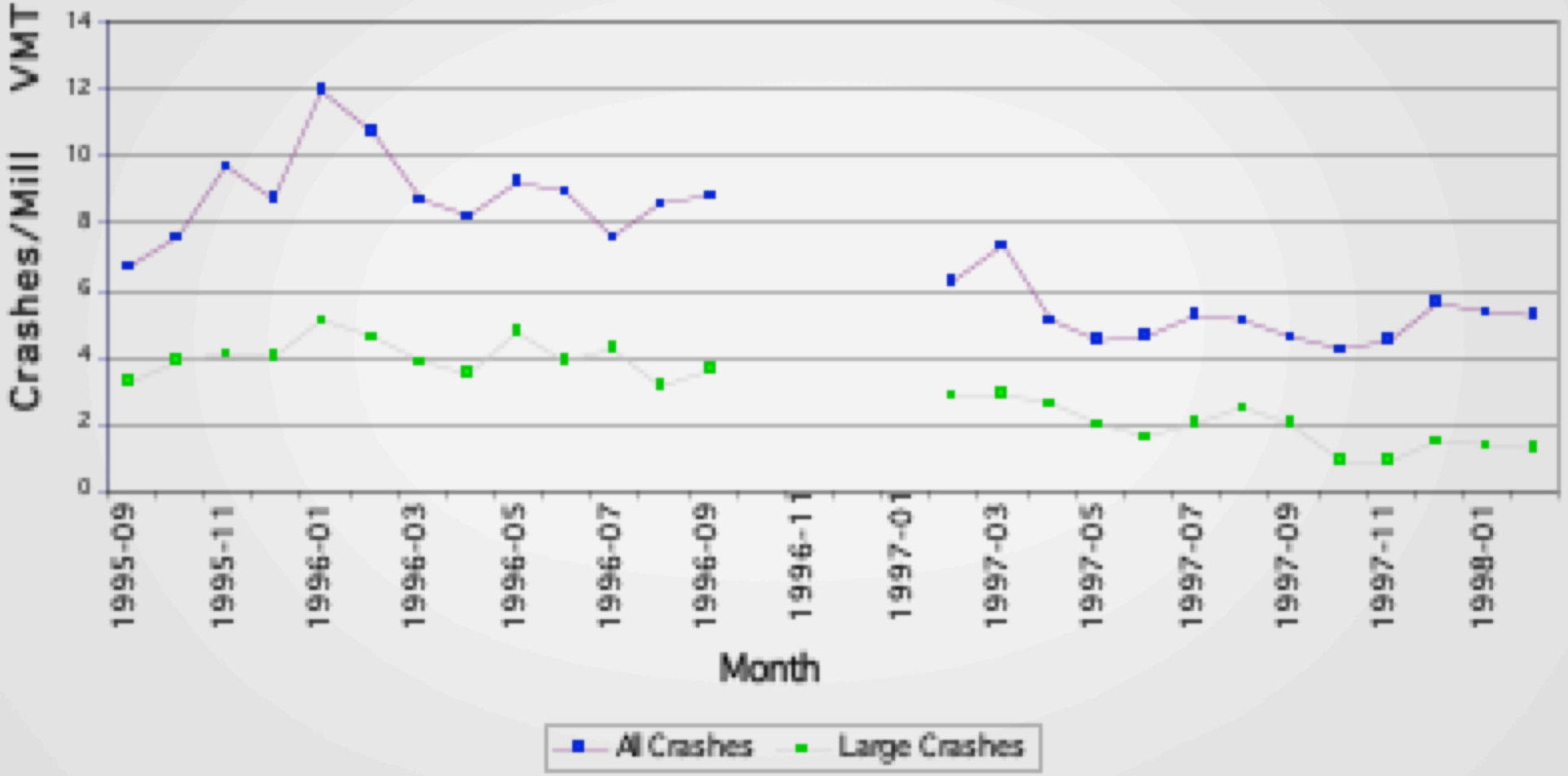
The Problem

- J. B. Hunt: The nation's second largest truckload carrier in 1995
  - 96% driver turnover
  - Carrier experienced driver safety and driver reliability problems

The Solution

- Raised wages by 38% in one major move
  - Before the raise: 37¢-40¢/mile (in 2018 dollars)
  - After the raise: 58¢-60¢/mile (in 2018 dollars)
- Closed down training schools & hired experience
- Focused on driver retention

Higher Pay, Lower Crash Rates



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Why safer drivers earn more money

- Efficiency Wage Hypothesis
  - Remember prior research estimated safe rate at 60¢/mi
  - Current market-clearing wage is about 42.5¢/mile for new hire with one year of experience
    - That's 27¢/mile in backward-bending labor supply curve
    - Average driver at that rate works 68 hours and needs to work more to pay bills.
  - Higher paid truck drivers have incentive to take fewer risks and work safely to retain a higher than market-clearing wage
    - Higher wages attract workers with better skills and safety records
    - This helps explain why higher wages are associated with fewer hours

Pay Level Findings

- **Overall, 10% higher driver pay was associated with 40% lower crash probability**
- Study method: survival analysis (Cox regression).
- At the mean, every penny more in first observed pay led to **11.1% lower crash probability**
- At the mean pay rate of 34¢ per mile (56¢ in 2019), every 10% higher first observed pay was associated with a **34% lower crash** probability
- A **10% pay increase** was associated with a **6% lower crash** probability
- At the mean, each **year of tenure** reduced crash probability by **16%**
- **Higher pay reduced turnover and increased age, experience, and other characteristics**

JB Hunt found there is a "Safe Rate"

Rate	Hours	
$0.286	69.2245482	Sample Mean
$0.307	69.7670643	Max Hours at $0.3075
$0.308	69.7650398	Tipping point for reduced work hours
$0.370	64.693353	Rate set by J.B. Hunt to reduce turnover & crashes
$0.394	60.1164762	SAFE RATE: 60 hours of work
$0.395	59.8941155	Rate required to reduce hours of work below legal limit

- Depends on society's preference for safety.
- I assume 60 hours per week (the legal limit) is the optimal tradeoff between efficiency and safety.
- The "safe rate" is the rate of pay needed to give drivers incentive to work 60 hours/week.
- **Using the DOL's CPI calculator, the "safe rate" in 2017 was $0.60/mile.**

"The association between truck driver compensation and safety performance"

Kudo and Belzer, 2019

- Using NIOSH Long Haul Truck Driver Survey data
- Efficiency wage theory suggests higher paid drivers safer
- Dependent variable: Expected value of the number of moving violations in past 12 months
- Zero-inflated negative binomial regression because of the number of null observations
- Significant independent variables
  - Mileage pay rate
  - Employment-based health care

Safe Rates and Return on Investment

Faulkiner and Belzer 2019

- ROI:
  - Lower paid inexperienced drivers: -25%
  - Higher paid experienced drivers: 285%
- Expected Net Present Value of higher paid experienced drivers is $10,474 greater than E(NPV) of lower paid inexperienced drivers, and stable over multiple years.
- Better paid drivers:
  - More experienced
  - Safer (lower crash cost and more reliable)
  - More productive (about 1,000 more miles/week)
  - More stable: stay with the company
    - Lower search, training, hiring cost
    - Lower turnover rates
    - Lower turnover fleets are safer

THE ECONOMIC FORCES UNDERLYING TRUCK DRIVER JOB STRESS

SOURCES

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- Belzer MH. (2018) Work-stress factors associated with truck crashes: An exploratory analysis. *The Economic and Labour Relations Review* 29:3. 289-307.

Work-Stress Leads to Truck Crashes

- This study used Large Truck Crash Causation Study (LTCCS) data to assess work linkage to safety
  - FMCSA, NHTSA, NASS supervised collection
  - 49 data sets total; 34 sets concatenated for this analysis
  - 1,000 variables; 967 crashes, including 1,127 large trucks, 251 fatalities, and 1,408 injuries
  - My analysis has 710 cases.
  - Dependent variable: “critical reason for the critical event”
    - Crash reconstruction method
- No valid compensation data recorded
- I created a work pressure index in addition to existing unique work-related variables

General Linear Model – ANOVA

Assigned Critical Reason [for critical event] =

$\alpha + \beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 + \beta_7 + \beta_8 + \varepsilon$

where:

β_1 = **Work Pressure Index** [ordinal continuous; 1-7]

β_2 = **Aggression Count** [computed ordinal; 1-10]

β_3 = **Fatigue** [discrete]

β_4 = **Class Years** [continuous]

β_5 = **Class Years Sq** [continuous]

β_6 = **Safety Bonus** [discrete]

β_7 = **Hours Driving** [this trip; continuous; 1-11]

β_8 = **Driver Reported Mileage Pay This Trip** [discrete]

ε = **unmeasured factors** (residual or error)

Work Stressors that Predict Crashes

Significant coefficients for the independent variables replace the betas in the equation.

Assigned Critical Reason for the Critical Event =

0.8318 +

β_1 (0.5822) Work Pressure Index* +

β_2 (1.484) Aggression Count* +

β_3 (0.9145) Fatigue +**

β_4 (-0.0231) Class Years* +

β_6 (-0.3187) Safety Bonus +**

β_7 (-0.0974) Hours Driving* +

β_8 (-0.2245) Mileage Pay This Trip + ε**

* Continuous ** Discrete

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Conservative conclusion based on LTCCS

- Workplace stress, together with “fatigue” and “safety bonus”, predicts about 15% of probability that the truck driver is last driver whose actions might have prevented the crash.
- Aggression count may be attributable to work pressure or personality; data are inconclusive.
- Predictive value of work pressure, fatigue, and safety bonus, is higher than any other factors in the LTCCS.
- Model does not include compensation.

DETENTION TIME:
EXTRA TIME DURING WHICH CARGO OWNERS HOLD UP DRIVER LOADING OR UNLOADING

SOURCES

- Dunn NJ, Hickman JS, Soccolich S, et al. (2014) “Driver Detention Times in Commercial Motor Vehicle Operations”. Washington: Federal Motor Carrier Safety Administration, xiv; 49.
- Office of the Inspector General. (2018) “Estimates Show Commercial Driver Detention Increases Crash Risks and Costs, but Current Data Limit Further Analysis.”
- Speltz E and Murray D. (2019) “Driver Detention Impacts on Safety and Productivity”. American Transportation Research Institute.

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Detention Time Adds More Risk

- Office of the Inspector General (DOT-OIG) did "detention time" study in 2017.
  - "Detention" defined as holding up driver more than two hours loading and/or unloading
  - OIG reports this is "industry standard"; does not measure all time
- Two-hour "industry standard" was created during the regulated era (before 1980), when tariffs allowed two hours of loading or unloading before cargo owner incurred "demurrage" charge.
  - Collective bargaining contracts required payment for all work time according to FLSA definition of work
  - Most drivers were paid for all time because 60% were Teamsters.
- After deregulation, shippers still expected two-hours free time.
  - Non-union trucking companies could not collect from cargo owners and stopped paying drivers.
  - Declining union bargaining power meant fewer drivers could collect.

Detention Time and ELDs/ELBs

- Electronic logbooks cannot determine driver activity.
- They record only that the truck is stopped.
  - FMCSA allows carriers to tell drivers to log off duty when they get to shipper or receiver.
  - FMCSA does not require that drivers report their activity at each change of duty; just location.
  - FMCSA inspectors have to take their word for it.
- Drivers log FLSA paid work time as off duty because they don't get paid
  - FMCSA permits this if company authorizes it.
  - This is why surveys show most drivers exceed 60 hrs

Detention Time and Logging

- ATA currently estimates the average length of haul at about 550 miles.
  - This means average driver may load and unload once/day.
  - Drivers give away up to four hours/day at little or no pay.
- Unpaid delay time values carrier and driver delay time at zero.
  - Detention kicks in after two hours
  - Carriers may find it hard to collect
  - No enforcement mechanism
- Economic principle
  - People will consume an infinite amount of a free good
  - Shippers and receivers have little incentive to conserve free carrier delay and labor time.

OIG Detention Time Study Results

- First 15-minute delay beyond 2 hours increases the average expected crash rate by 6.2%.
  - Adds one additional crash per 1,000 power units
  - 6,509 additional crashes per year
  - Every 5 percentage point increase in proportion of stops resulting in detention linked to 4.7% increase in expected crash rate
- 2014 FMCSA detention study found that
  - 10% of all stops experienced 2+ hours detention time
  - For those stops, delay time averaged 1.4 hours
    - This means 10% of all stops had total stop time 3.4 hours
  - Smaller carriers had more delay than larger carriers

Detention Time Costs Money

- Detention is associated with between $1.1 billion to $1.3 billion lower annual earnings for for-hire CMV drivers in the truckload sector.
  - That's between $1,281 and $1,534 per driver per year
  - Helps to explain labor shortage
- Detention reduces motor carrier net income by $250.6 to $302.9 million per year
- Unpaid delay time contributes to excessive driver labor time
- Excessive labor times drives up crash risk

Summing Up

- The low road costs the economy billions of dollars yearly
  - Wasted time for drivers
  - Wasted time for carriers
  - Major contribution to the perceived “driver shortage”
- Encourages inefficient use of all resources
  - Labor
  - Capital
  - Reduces American Gross Domestic Product
- Has profound safety and health cost, which also reduces GDP
- Because commercial transport is a business, economic forces explain safety and health outcomes
- Economic approach to safety and health points the way to policy solutions
- Safe rates will save lives, allocate resources efficiently, and grow the economy

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Supplemental Resources

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