Workplace Injury and the Labor Supply of Traffic Officers

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Motivation

- ▶ Workplace injuries cost \$170.8 billion in 2018
- Intensive labor supply varies significantly across people.
- Individuals understand their own injury risk on a given day
 - Example: Parent who stayed up all night caring for a sick child.
- Research question: Do people consider individual workplace injury risk when making labor supply decisions?



Preview Of Results

▶ Individual injury risk plays a large role in daily labor supply decisions.

- Labor supply is downward sloping in injury risk.
- Officers are less likely to work when they are more likely to be injured.
- ▶ This creates economically significant positive self-selection.
 - Observed injury rate is 8.5 times smaller than the underlying average rate.
- **Implication:** Imposing overtime equality across workers can increase injury rates.
- ▶ Implication: Shift auctions reduce injuries 34 percent over random lists in simulations.
- Implication: Studies reporting observed injury rates may underestimate the underlying rate.

Los Angeles Traffic Officers

- Unionized and FLSA covered employees of the City of LA.
- Job tasks: traffic direction and distributing parking citations.
- Middle of the road injury risk among public safety occupations (BLS)



Los Angeles Traffic Officers

- 553 full time officers analyzed between Jan. 2015 and Sept. 2016 (609 days)
- Median hourly wage is \$30.54.
- Median officer is 45 years old with 12 years tenure.
- ▶ 34% experience at least one injury.

Demographics

Pay Stats

- Top 3 injuries: strain, contusion, sprain. Most serious: stroke, heat prostration
- Common Causes: Vehicle collisions, physical activity.



Overtime Assignment Process



- Daily pay records documenting rate of pay, type of pay (sick, standard, overtime, etc), work location and number of hours.
- ▶ Workers compensation claims documenting workplace injuries.
- Additional weather statistics
- ► Together, this yields a panel of 553 traffic officers over 609 days.

Most variation in overtime is along the day margin.

One officer works 601 of 609 days!

 Puzzle: injured employees work less than uninjured (even after adjusting for truncation due to leave)

- ▶ Thus, unobserved positive selection is a feature of the data.
- ▶ This motivates a simple labor supply model incorporating injury risk.

Model - Framework

- Officers indexed by i and time indexed by t.
- work decision (w_{it}), underlying injury outcome (y^{*}_{it}), observed injury outcome (y_{it} := y^{*}_{it} · w_{it})

$$y_{it}^{*} = \begin{cases} 1 \text{ if } \zeta_{2} + X_{it}^{\prime}\beta + \underbrace{c_{i2} + u_{it2}}_{\text{unobserved injury propensity}} \geq 0\\ 0 \text{ otherwise} \end{cases}$$

Officers are expected utility maximizers:

$$w_{it} = \begin{cases} 1 \text{ if } Z'_{it}\alpha + \zeta_1 + \underbrace{c_{i1} + u_{it1}}_{\text{unobserved utility}} \ge 0\\ 0 \text{ otherwise} \end{cases}$$

(2)

(1)

Model - Identification

• Given $-1 \le \rho \le 1$ assume that conditional on Z_i, X_i :

$$\begin{pmatrix} c_{i1} + u_{i1} \\ c_{i2} + u_{i2} \end{pmatrix} \sim N\left(\begin{bmatrix} \bar{Z}_i \gamma_1 \\ \bar{Z}_i \gamma_2 \end{bmatrix}, \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix} \right)$$

• Intuitively, ρ captures how unobserved risk impacts labor supply.

- Identification achieved as long as Z_{it} contains an excluded instrument.
- Shared elements of X_{it}, Z_{it} include temperature, rain, day of the week and month indicators, location indicators, age, holiday indicator

Labor Supply as a Function of Injury Risk

Under this framework, I can define the average labor supply as a function of unobserved injury risk:

$$L(\mathbf{v}) := E_{z_{i,t},\bar{z}_i} \left[\Phi\left(\frac{\zeta_1 + z_{i,t}' \alpha + \bar{z}_i' \gamma_1 + \rho \mathbf{v}}{(1-\rho^2)^{1/2}}\right) \right]$$

• The slope of L(v) is completely determined by the sign of ρ (which we can estimate).

Instruments

- Leave of coworkers in division: # of other officers in same physical office taking bereavement/sick/vacation on the day.
- Cumulative potential contacts: # of currently employed officers that have worked in the same location as officer i in the past.
- Seniority: rank in terms of number of years since hire among all officers in the current division.

Recall the Diagram

What do these need to satisfy?

- Relevance: They must matter to the work decision.
- Exclusion: They must not impact injury except through the work decision.
 I can use the panel structure to weaken this, so that mean dependence is ok.

Statistical tests suggest these are satisfied. 2SLS Tests Balance Test

Relevance: Leave of Coworkers



Relevance: Cumulative Potential Contacts



Structural Estimates

Description	Analytical Representation	Estimate
Unobserved Idiosyncratic Correlation ($ ho$)	$Cor(a_{i1}+u_{it1},a_{i2}+u_{it2})$	6241 (.17803)
Conditional Injury Probability	$E_{z_{it}}[Pr(y_{it=1} w_{it}=1\& z_{it})]$.0013
Unconditional Injury Probability	$E_{v,z_{it}}[Pr(y_{it=1} z_{it} \& v)]$.0119
Variance Time-Invariant Work Utility	$Var(ar{Z}_i\gamma_1)$.1503
Variance Time-Invariant Injury Propensity	$Var(ar{Z}_i\gamma_2)$.1108
Correlation Time-Invariant Components	$Cor(ar{Z}_i\gamma_2,ar{Z}_i\gamma_2)$	4664
Total Correlation Unobserved Utility/Injury	$rac{ ho+ ext{Cov}(ar{Z}_i\gamma_2,ar{Z}_i\gamma_2)}{1+ ext{Var}(ar{Z}_i\gamma_1)^{1/2} ext{Var}(1+ar{Z}_i\gamma_2)^{1/2}}$	6053 (.)



Estimated Labor Supply Function (L(v))



Work Probability Elasticities

Wage	2.270*** (0.214)	12.82* (5.830)
Leave of Coworkers (count)	0.0429*** (0.00551)	0.250 (0.135)
Cumulative Officer Potential Contacts	0.0510* (0.0205)	0.170 (0.110)
Seniority Rank	0.0229 (0.0118)	0.0779 (0.0616)

Another Perspective: Injury Rate Conditional on Leave of Coworkers



Application: Shift Auctions

- Shift bidding: officers submit a wage for an extra shift, the shift goes to the lowest bidder.
- Officers will bid their true value for the shift. Since value is strongly negatively correlated with injury risk, this should reduce injury.
- ▶ Does it work? Yes! An auction reduces injury risk by 34% compared to a random list.

Application: Shift Auctions



Application: Value of a Statistical Injury

- Since I have wage variation, I can compute the value of a statistical injury.
- VSI: a worker would pay to decrease the probability of injury by 1/n, multiplied by n.
- Intuitively: the amount of money the officers would collectively pay to decrease the number of injuries by 1.

Lower Bound $(M = 1)$	Up	per Bound ($M = 2$)	
Willingness to Pay	VSI	Willingness to Pay	VSI
\$0.483 \$1	25,445.6	\$0.965	\$250,891.2
(0.893) (23	32,094.9)	(1.786)	(464,189.8)

Willingness to Pay Varies





- ▶ Individual injury risk plays a large role in labor supply decisions of traffic officers.
- Officers supply less labor when their risk is elevated, inducing positive selection in the workforce.

Policy Implications

- Enforcing ex-post equality in overtime may elevate injury rates by hindering natural positive selection.
- Mandatory overtime is much more dangerous than voluntary overtime.
- Within-job labor supply and workplace injury are tightly linked. More work should explore how this aggregates across the economy.

Demographics

	Mean	Std. Dev.	p10	p50	p90
Not Injured					
Age	44.48	10.09	30.11	44.06	58.43
Tenure (years)	13.11	8.63	2.86	12.41	26.49
Divisions Worked In	1.26	0.46	1.00	1.00	2.00
Injured					
Age	46.43	8.88	35.13	46.63	58.31
Tenure (years)	14.26	8.24	6.20	11.99	26.49
Divisions Worked In	1.24	0.45	1.00	1.00	2.00
Total					
Age	45.14	9.73	32.03	44.65	58.31
Tenure (years)	13.49	8.51	3.42	11.99	26.49
Divisions Worked In	1.25	0.46	1.00	1.00	2.00



Pay Statistics

	Mean	Std. Dev.	p10	p50	p90
Hourly Wage	30.10	2.33	26.56	30.54	32.22
Regular Pay	1236.11	716.25	244.00	1220.00	2135.00
Overtime Pay	287.60	488.18	0.00	0.00	967.00
Proportion OT	0.11	0.14	0.00	0.00	0.33
Observations	43004				

Back

Distribution of Time Worked

Days worked in a 4 week Periou						
	Mean	Std. Dev.	p10	p50	p90	
Not Injured	18.15	4.44	13.00	19.00	23.00	
Injured	17.54	4.24	12.00	18.00	22.00	
Total	18.03	4.41	13.00	19.00	23.00	
N	8378					

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Hours Worked						
Mean Std. Dev. p10 p50 p90						
Not Injured	9.00	2.70	8.00	8.00	13.00	
Injured	8.94	2.62	8.00	8.00	13.00	
Total	8.98	2.67	8.00	8.00	13.00	
N	183659					

Balance Test: Medical Expenses of Injury

	(1)	(2)	(3)	(4)
Leave of Coworkers (count)	3.849	26.04	84.99	106.4
	(29.66)	(47.53)	(64.66)	(66.27)
Cumulative Officer Potential Contacts	-5.590	-1.467	-2.044	-4.170
	(6.702)	(6.974)	(7.144)	(7.774)
Seniority Rank	-6.425	1.949	-0.908	-1.276
	(9.588)	(9.083)	(9.538)	(9.553)
Observations	257	257	257	257
F.	0.409			
Division FE	No	Yes	Yes	Yes
Day of Week FE	No	No	Yes	Yes
Month FE	No	No	No	Yes

Tests of Analogous FE-2SLS Specification

	(1)	(2)	(3)	(4)
work	0.00271***	0.00244***	0.0101***	0.00458***
	(0.000340)	(0.000304)	(0.00362)	(0.00229)
Ν	259861	259861	259861	259861
Underid K-P LM-stat	340.5	347.0	36.67	64.04
Cragg-Donald F-Stat	20617.6	22900.0	230.6	506.6
Weak id. K-P F-stat	1167.4	1191.9	13.47	26.31
Hansen J	5.189	2.995	0.929	
Hansen J p	0.0747	0.224	0.628	
Division FE	No	Yes	Yes	Yes
Day of Week/Month FE	No	No	Yes	No
Date FE	No	No	No	Yes

Coefficient Estimates

	Injury	Work
Wage	0.0434	0.150***
	(0.0606)	(0.0135)
Leave of Coworkers (count)		0.0189***
		(0.00242)
Cumulative Officer Potential Contacts		0.00192**
		(0.000767
Seniority Rank		0.00152*
-		(0.000781)
Observations	259861	