Estimating Officer Risk Factors for Police Shootings

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Police Use of Lethal Force Sparks Unrest

- 2001 Cincinnati PD shooting of Timothy Thomas resulted in 4 days of riots and $3.6M in damage

- 2006 NYPD shooting of Sean Bell, 50 shots fired. Officers found not guilty at trial, but fired or resigned

- 2014 Chicago PD shooting of Laquan McDonald. Multiple officers on scene. Only one shoots.

Outline

- Existing research on police shootings
- Analytical approach
- Analysis of NYPD police shootings
- Summary

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Shooters and Nonshooters Work in Different Environments

- Fyfe (1978) reported black NYPD officers were twice as likely as white officers to have shot at citizens
  - Black officers more likely in "high experience precincts"
  - less likely in managerial ranks (Fyfe 1981)
- McElvain & Kposowa (2008) studied Riverside County deputies
  - Shooters were more likely to be male, Hispanic, no college, younger, and in lower ranks
- Pew Research Center reported that white officers and officers favoring gun rights are more likely to have fired their gun

We want to know factors affecting shooting risk
Not indicators of where officers work

Assessing Officer Risk Factors Requires Controlled Comparison

- Officers that discharge their weapons often look different from other officers in obvious ways
  - In the field
  - In particular neighborhoods
  - Conducting higher risk operations
  - Not at a desk

"There is virtually no empirical support for assertions that individual officer characteristics are measurably related to any type of performance in office" – Fyfe (1989)

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Compare Shooting and Nonshooting Officers on the Same Scene

1. Multiple officers on the scene
2. They all share the same environment features
3. Test whether officers with certain features are more likely to be the shooter

Odds of Shooting Depend on Environment and Officer Features

$$\textbf{odds of shooting} = \mathbf{1.1} \times \mathbf{1.6} \times \mathbf{0.9}$$

- Officer is in a high risk environment

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- Officer is in a high risk environment
- Officer has many negative marks in file

Odds of Shooting Depend on Environment and Officer Features

$$\textbf{odds of shooting} = \mathbf{1.1 \times 1.6 \times 0.9}$$

- Officer is in a high risk environment
- Officer has many negative marks in file
- Officer joined NYPD at age 30

Odds of Shooting Depend on Environment and Officer Features

$$\mathbf{odds\ of\ shooting} = \mathbf{1.1} \times \mathbf{1.6} \times \mathbf{0.9} = \mathbf{1.58}$$

- Officer is in a high risk environment
- Officer has many negative marks in file
- Officer joined NYPD at age 30

Very difficult to collect enough data on environment and monitor police in all scenarios to estimate these risk factors

One of Two Officers Shoot, We Can Guess Who Shot

$$\frac{P(A\ \text{shoot})}{1 - P(A\ \text{shoot})} = 1.1 \times 1.6 \times 0.9$$

$$\frac{P(B\ \text{shoot})}{1 - P(B\ \text{shoot})} = 1.1 \times 0.5 \times 1.1$$

$$P(A\ \text{shoots} | A\ \text{or}\ B\ \text{shoots}) = \frac{1.1 \times 1.6 \times 0.9}{1.1 \times 1.6 \times 0.9 + 1.1 \times 0.5 \times 1.1}$$

Low Risk Environment? Environment Cancels Out

$$\frac{P(A\ \text{shoot})}{1 - P(A\ \text{shoot})} = 0.2 \times 1.6 \times 0.9$$

$$\frac{P(B\ \text{shoot})}{1 - P(B\ \text{shoot})} = 0.2 \times 0.5 \times 1.1$$

$$P(A\ \text{shoots} | A\ \text{or}\ B\ \text{shoots}) = \frac{0.2 \times 1.6 \times 0.9}{0.2 \times 1.6 \times 0.9 + 0.2 \times 0.5 \times 1.1}$$

High Risk Environment?
Environment Cancels Out

$$\frac{P(A\ \text{shoot})}{1 - P(A\ \text{shoot})} = 5.0 \times 1.6 \times 0.9$$

$$\frac{P(B\ \text{shoot})}{1 - P(B\ \text{shoot})} = 5.0 \times 0.5 \times 1.1$$

$$P(A\ \text{shoots} \mid A\ \text{or}\ B\ \text{shoots}) = \frac{5.0 \times 1.6 \times 0.9}{5.0 \times 1.6 \times 0.9 + 5.0 \times 0.5 \times 1.1}$$

One of Two Officers Shoot, We Can Guess Who Shot

$$\frac{P(A\ \text{shoot})}{1-P(A\ \text{shoot})} = 1.1 \times 1.6 \times 0.9$$

$$\frac{P(B\ \text{shoot})}{1-P(B\ \text{shoot})} = 1.1 \times 0.5 \times 1.1$$

$$\frac{1.6 \times 0.9}{1.6 \times 0.9 + 0.5 \times 1.1} = 0.72$$

Chance that Officer A shot depends only on her features
We do not need to measure environmental features

I Solve the Inverse Problem, Observe Who Shoots, Infer Parameters

$$\frac{P(A \text{ shoot})}{1 - P(A \text{ shoot})} = \cancel{1.1} \times \beta_1 \times \beta_2$$

$$\frac{P(B \text{ shoot})}{1 - P(B \text{ shoot})} = \cancel{1.1} \times \beta_3 \times \beta_4$$

Shooter

Nonshooter

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Utilized Data on a Review of Three Years of Records

- Gathered data on all shooting incidents adjudicated in 2004, 2005, and 2006
- For each shooting I recorded
  - department ID numbers for shooters in the incident
  - department ID numbers for non-shooting officers that were witnesses or in the immediate vicinity of the shooting
- 106 incidents involving 150 shooting officers and 141 non-shooting officers
- Collected data on age, experience, education, training, and past performance

Who Is More Likely to Shoot?

Variable	Risk difference
Rank	
Police officer (reference)	
Detective	
Sergeant	
Lieutenant	
Captain	

Supervisors and Management Ranks Are Less Likely to Shoot

Variable	Risk difference
Rank	
Police officer (reference)	
Detective	No difference
Sergeant	-74%
Lieutenant	-95%
Captain	-96%

Who Is More Likely to Shoot?

Variable	Risk difference
Rank	
Police officer (reference)	
Detective	No difference
Sergeant	-74%
Lieutenant	-95%
Captain	-96%
Male	

Men and Women Equally Likely to Shoot

Variable	Risk difference
Rank	
Police officer (reference)	
Detective	No difference
Sergeant	-74%
Lieutenant	-95%
Captain	-96%
Male	No difference

Who Is More Likely to Shoot?

Variable	Risk difference
Rank	
Police officer (reference)	
Detective	No difference
Sergeant	-74%
Lieutenant	-95%
Captain	-96%
Male	No difference
Race	
White (reference)	
Black	
Hispanic	

Black Officers More Likely to Shoot

Variable	Risk difference
Rank	
Police officer (reference)	
Detective	No difference
Sergeant	-74%
Lieutenant	-95%
Captain	-96%
Male	No difference
Race	
White (reference)	
Black	+226%
Hispanic	No difference

Older Recruits Have a Sustained Lower Risk of Shooting

Variable	Risk difference
Rank	
Police officer (reference)	
Detective	No difference
Sergeant	-74%
Lieutenant	-95%
Captain	-96%
Male	No difference
Race	
White (reference)	
Black	+226%
Hispanic	No difference
Years at NYPD	No difference
Age when recruited	-11%
Education	No difference
Special assignment	No difference

What Kinds of Prior Activity Signal Increased Shooting Risk?

Variable	**Risk difference**
Average annual	
Evaluation score < 3.5	
Range score < 86	
Complaints > 0.6	
Medal count > 3.8	
CPI points > 3.1	
Gun arrests > 2.4	
Felony arrests > 9.3	
Misdemeanor arrests > 10.0	
Days of leave	

Rapid Accumulation of Negative Marks Signals Elevated Shooting Risk

Variable	Risk difference
Average annual	
Evaluation score < 3.5	
Range score < 86	
Complaints > 0.6	
Medal count > 3.8	
CPI points > 3.1	+212%
Gun arrests > 2.4	
Felony arrests > 9.3	
Misdemeanor arrests > 10.0	-80%
Days of leave	

8% of NYPD officers
15% of shooting scene officers

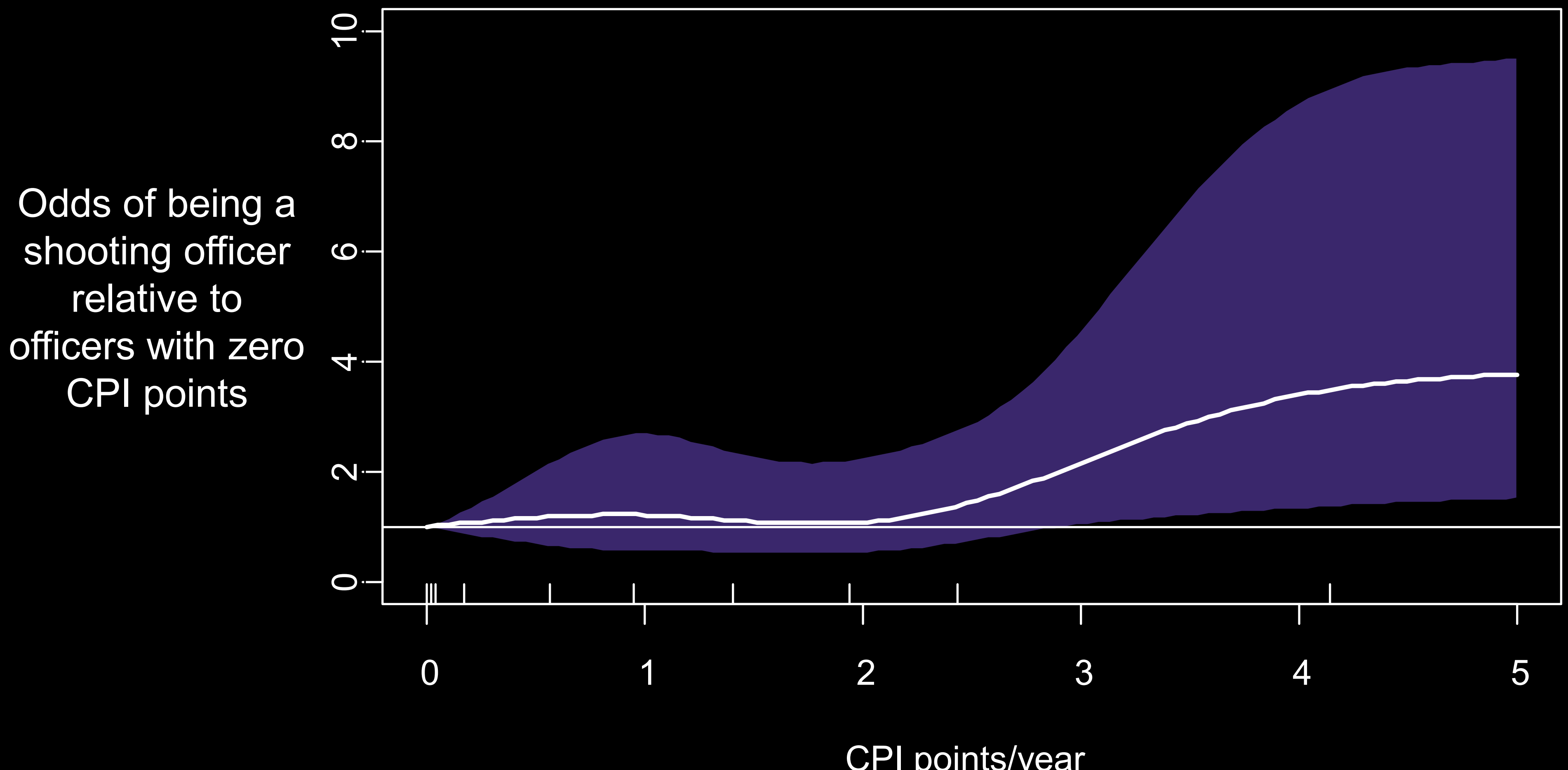
Central Personnel Index Assign Points to Problematic Incidents

Event	Point value
Suspension	8
Loss of firearm	6
Negative evaluation - A	5
Fail to safeguard weapon	5
Chronic sick – B	4
Loss of shield	4
Negative evaluation – B	3
Chronic sick – A	2
Firearm discharge	1
Dept. auto accident	1

```
NEGATIVE EVALUAT. - B          10 MONTH EVAL - 3.0
DATE       : 04/30/2005        (1) LOW - BEHAV DIMENS
CONTROL #: 003
SERIAL   #: XXXX

FIREARMS DISCHARGE             NO VIOLATION
DATE       : 06/09/2006        NO CORRECTIVE ACTION
CONTROL #: 004
```

Exceeding 3.1 CPI/year Strongly Associated with Shooting Risk



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Summary

- Proper analysis of shooting incidents can tease out factors contributing to risk
  - Solves Fyfe's 30-year old challenge
- Implications for recruiting, monitoring, and assignments
  - Attract older recruits
  - Monitor those rapidly accumulating negative marks
- Police should maintain data on all officers on the scene of a shooting, including count of rounds fired

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“Active” Officer May Be Key Factor

Variable	Risk difference
Average annual	
Evaluation score < 3.5	No difference
Range score < 86	No difference
Complaints > 0.6	+107%
Medal count > 3.8	+128%
CPI points > 3.1	+212%
Gun arrests > 2.4	No difference
Felony arrests > 9.3	+115%
Misdemeanor arrests > 10.0	-80%
Days of leave	No difference

With Two Officers on a Shooting Scene, We Can Guess Who Shot

$$\frac{P(A\text{ shoot})}{1-P(A\text{ shoot})} = 1.1 \times 1.6 \times 0.9$$

$$\frac{P(B\text{ shoot})}{1-P(B\text{ shoot})} = 1.1 \times 0.5 \times 1.1$$

$$P(A\text{ shoots}|A\text{ or }B\text{ shoots}) = \frac{P(A\text{ shoot})P(B\text{ no shoot})}{P(A\text{ shoot})P(B\text{ no shoot}) + P(A\text{ no shoot})P(B\text{ shoot})}$$

With Two Officers on a Shooting Scene, We Can Guess Who Shot

$$\frac{P(A\ \text{shoot})}{1-P(A\ \text{shoot})} = 1.1 \times 1.6 \times 0.9$$

$$\frac{P(B\ \text{shoot})}{1-P(B\ \text{shoot})} = 1.1 \times 0.5 \times 1.1$$

$$\frac{\frac{1.1 \times 1.6 \times 0.9}{1+1.1 \times 1.6 \times 0.9}\left(\frac{1}{1+1.1 \times 0.5 \times 1.1}\right)}{\frac{1.1 \times 1.6 \times 0.9}{1+1.1 \times 1.6 \times 0.9}\left(\frac{1}{1+1.1 \times 0.5 \times 1.1}\right) + \left(\frac{1}{1+1.1 \times 1.6 \times 0.9}\right)\frac{1.1 \times 0.5 \times 1.1}{1+1.1 \times 0.5 \times 1.1}}$$

Learn the Factors Affecting the Probability of Shooting

$$\log \frac{P(S = 1|\mathbf{x}, \mathbf{z})}{1 - P(S = 1|\mathbf{x}, \mathbf{z})} = h(\mathrm{z}) + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_d x_d$$

- S is 1 if the officer shoots
- x are the officer's features
- z are the features of a particular scenario (kinds of suspects involved, location, and lighting)

Collected data do not quite match this framework

Consider the Likelihood of a Shooting Involving Two Officers

$$P(S_A = 1, S_B = 0 | S_A + S_B = 1, \mathbf{x}_A, \mathbf{x}_B, \mathbf{z}) =$$

Substituting Simplifies the Model

$$\frac{P(S_A = 1|\mathbf{x}_A, \mathbf{z}) \qquad P(S_B = 0|\mathbf{x}_B, \mathbf{z})}{\quad} =$$

$$=$$