Transit Systems and Their Effect on Crime in Communities
Three Decades of Crime and Transit in Los Angeles

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Belief that Transit Brings Crime

- Prompted by the extension of Metro Rail to Santa Monica, California
- Plano (1993) compared crime in the year before and year after three stations opened in Baltimore, compared to the rest of Baltimore County
  - Found no effect
- Poister (1996) examined two stations in Atlanta 2½ before and 1½ years after opening
  - Found no effect
- Block and Block (2000) found higher robbery rates around 1-2 blocks away from transit stops in Chicago and New York
  - also more likely to be located near bars and other businesses that may be sources of crime
- Ihlanfeldt (2003) studied transit expansion in Atlanta from 1991-1994, crime increased near downtown and decreased in the suburbs
- Liggett et al. (2003) studied 14 new Metro Rail "Green Line" stations connecting poor neighborhoods to more affluent neighborhoods
  - compared the crime rates for the five years before and after opening relative to the local city or larger jurisdiction in which each station was located
  - Found crimes increase in six out of the fourteen station areas relative to the adjacent areas in which each station was situated

Though Best Known for Freeways, Los Angeles Has Built an Extensive Rail System

- 1961 the last of the Pacific Electric rail lines ended service

- 1961-1990 Los Angeles was the largest city in the U.S. without a rail transit system

- 1990 Los Angeles opened the Blue Line

- 2014 Los Angeles had six lines covering 87 miles of service, carrying more than 300,000 daily riders
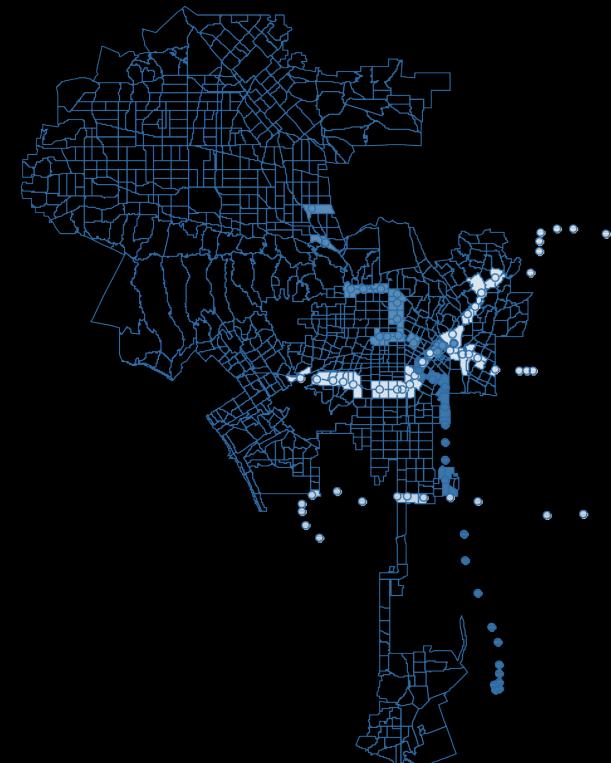
Los Angeles Presents a Special Opportunity to Assess the Effect of Transit on Crime

1. Data on crime trends cover the entire expansion of Metro Rail in the second largest U.S. city

2. The time series is nearly three decade long

3. Compare crime near stations before and after opening and with areas eventually having stations

4. Transit labor union went on a 32-strike in 2000 and a 35-day strike in 2003

Data From 1988-2004 Collected from 2,300 Pages at LA Library
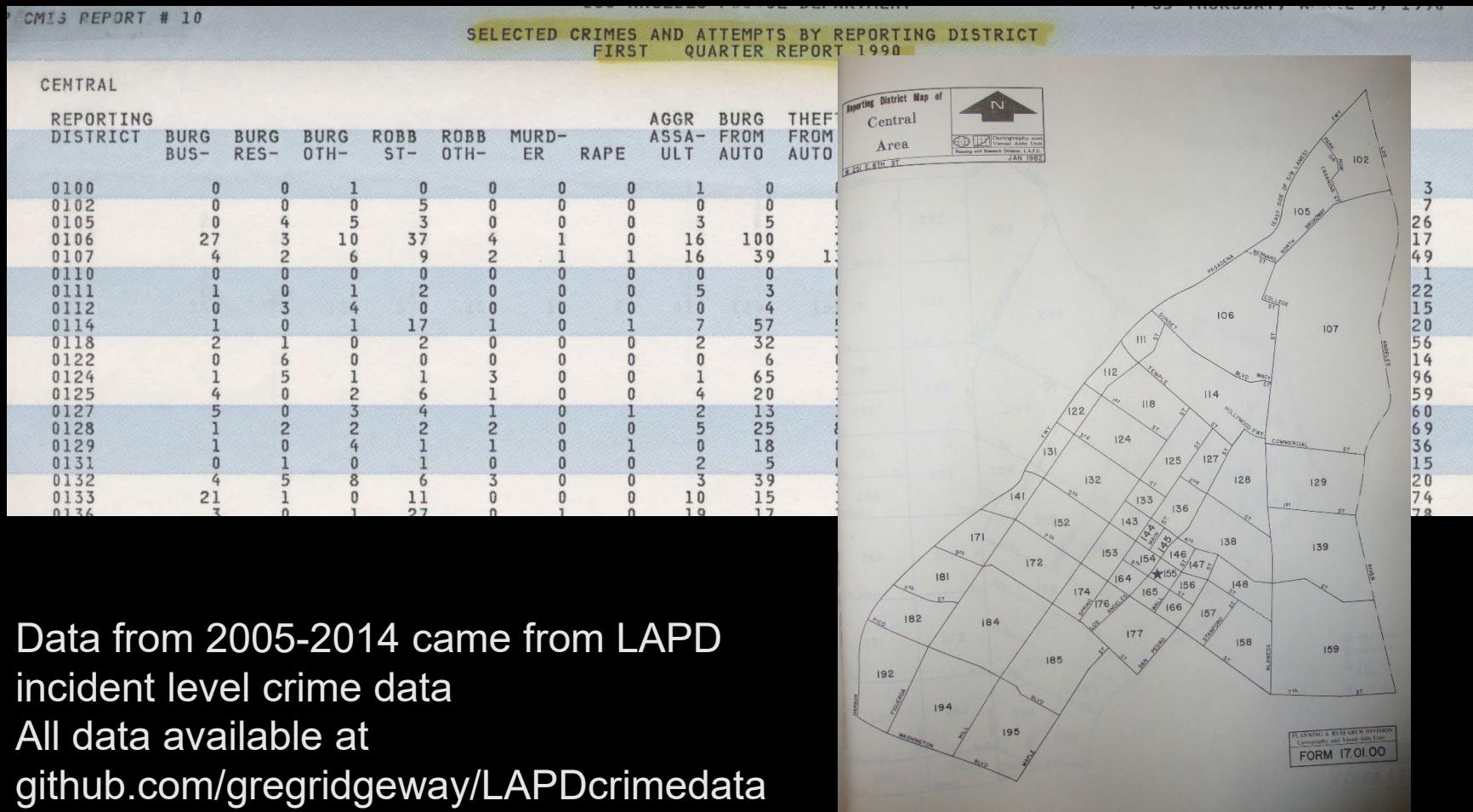
- Data from 2005-2014 came from LAPD incident level crime data
- All data available at github.com/gregridgeway/LAPDcrimedata

Identification Strategy Relies on the Staged Rollout of Metro Rail over 30 Years
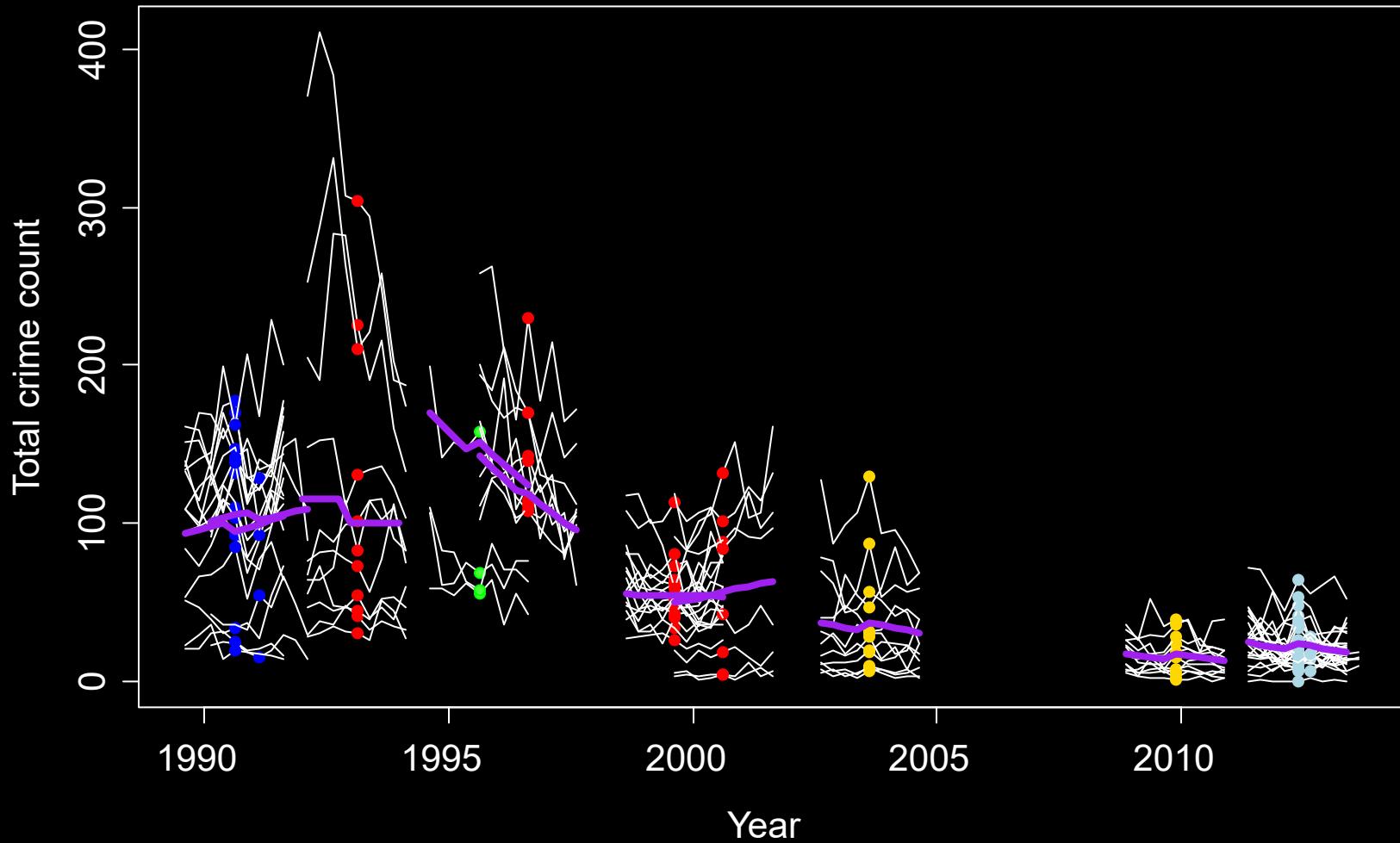
Isolate Effect of Transit Using Four Approaches

- *Stepped wedge design* – compare RDs with and without stations over time

- *Effect modification* – measure the effect for "high crime" and "low crime" RDs

- *Short term, station RDs only* – analyze only RDs with stations in the year before and after a station

- *Two labor strikes* – use the strikes to assess crime changes before, during, after the system shutdown

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Stepped Wedge Design Detects Shifts in Crime Rates When Stations Open

$$\log(\lambda_{it}) = \beta_0 + \beta_1 \text{station}_{it} + \alpha_i + \gamma'_{\text{division}(i)} ns_{15}(t)$$

- RDs have a station if the station is within 200m of the RD boundary
- 281 RDs within 1km of an eventual station
- 116 RDs will eventually have a station
- α_i is the RD fixed effect
- Allow for a separate crime trend in each division across the 108 quarters
- Computed permutation p-values by randomly exchanging station openings between RDs

Slight, Non-Significant Decline in Crime After Station Opening

Crime type	Average crime count per RD per year	% crime increase	95% CI	Permutation p-value
Total	216.9	-2.6	(-6.2, 1.2)	0.21

Most Crime Types Decline After Station Opening, None Significant

Crime type	Average crime count per RD per year	% crime increase	95% CI	Permutation p-value
Total	216.9	-2.6	(-6.2, 1.2)	0.21
Assaults	39.8	-3.9	(-9.4, 1.9)	0.17
Burglary/theft from vehicle	58.3	-3.6	(-9.9, 3.1)	0.34
Burglary	34.5	-2.2	(-8.1, 4.2)	0.51
Auto theft	46.1	-3.8	(-9.3, 2.0)	0.17
Grand theft person	4.5	-6.9	(-19.0, 7.1)	0.35
Homicide	0.9	4.6	(-8.6, 19.7)	0.51
Robbery	32.8	-0.9	(-7.9, 6.6)	0.77

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Interaction of Station and Crime Class Modifies Station Effect

$$\log(\lambda_{it}) = \beta_0 + \beta_1 \text{station}_{it} + \\ \beta_2 \text{station}_{it} \times \text{low}_{it} + \beta_3 \text{station}_{it} \times \text{high}_{it} + \\ \gamma'_{\text{division}(i)} ns_{15}(t) + \alpha_{\text{division}(i),t}$$

- RDs low, medium, or high crime depending on crimes/km^2 in quarters $t - 1$ and $t - 2$

- β_2 and β_3 indicate whether the station effect differs by the crime level in an RD

- α_i is the division fixed effect

- Allow for a separate crime trend in each division across the 108 quarters

Low Precision Makes It Difficult to Measure Effects Modification

| Crime type	% increase in crime in low crime RDs	95% CI	Permutation p-value	% increase in crime in high crime RDs	95% CI	Permutation p-value
Total	-10.3	(-27.3, 10.8)	0.35	-5.9	(-28.2, 23.4)	0.70

Low Precision Makes It Difficult to Measure Effects Modification

| Crime type	% increase in crime in low crime RDs	95% CI	Permutation p-value	% increase in crime in high crime RDs	95% CI	Permutation p-value
Total	-10.3	(-27.3, 10.8)	0.35	-5.9	(-28.2, 23.4)	0.70
Assaults	-2.3	(-30.0, 36.4)	0.88	-3.4	(-32.8, 38.9)	0.88
Theft from vehicle	-22.0	(-37.7, -2.4)	0.12	-9.2	(-31.9, 21.3)	0.61
Burglary	-14.1	(-31.9, 8.4)	0.18	8.8	(-19.7, 47.2)	0.61
Auto theft	-0.3	(-20.1, 24.4)	0.98	4.7	(-21.1, 39.0)	0.77
Grand theft person	-4.6	(-45.8, 68.0)	0.87	-11.7	(-51.1, 59.4)	0.69
Homicide	-2.4	(-30.0, 36.3)	0.89	8.5	(-22.8, 52.5)	0.69
Robbery	-5.8	(-32.3, 31.2)	0.67	-24.8	(-47.4, 7.4)	0.13

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Examining Only Station RDs Avoids Confounding of Opening and Crime
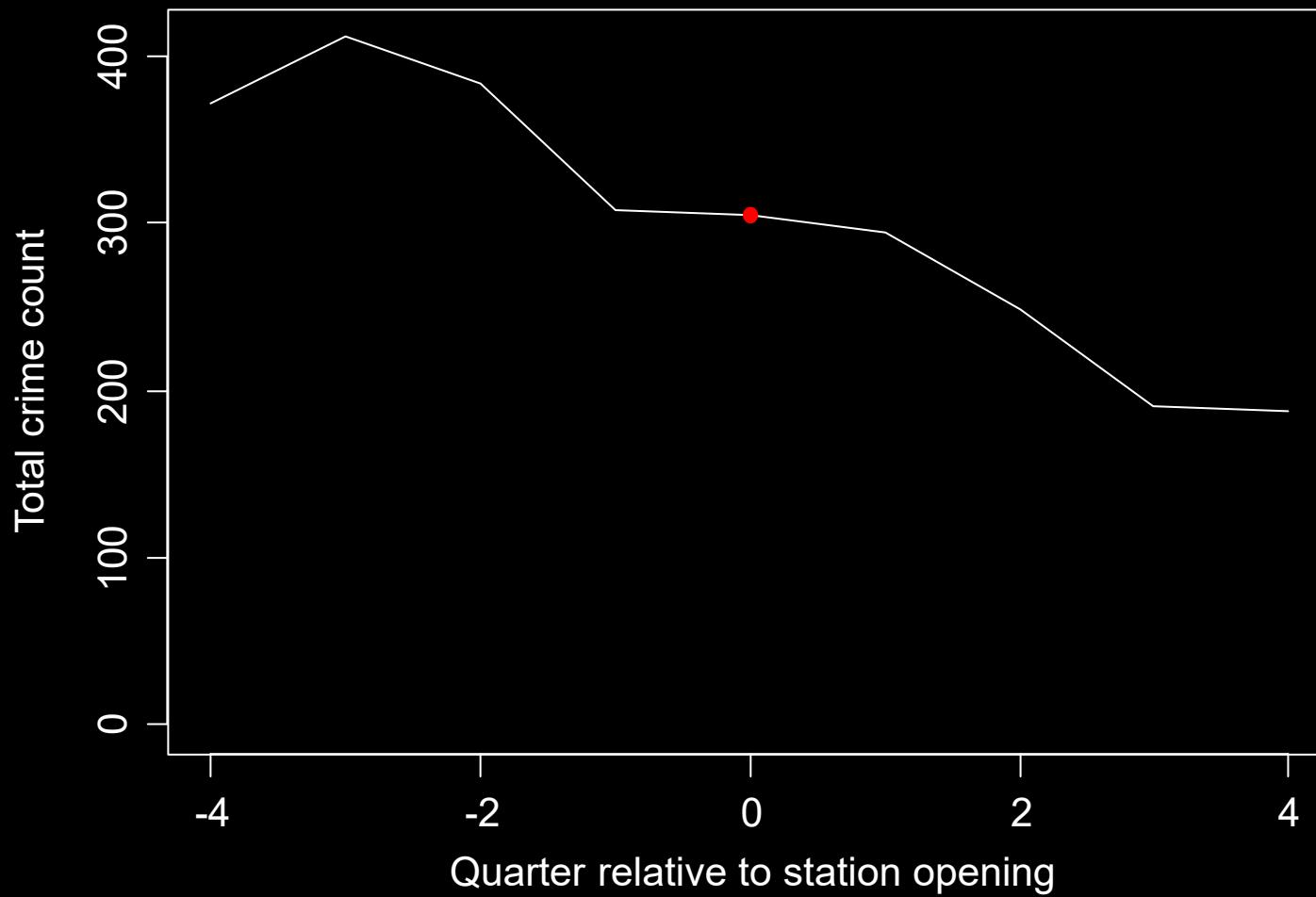
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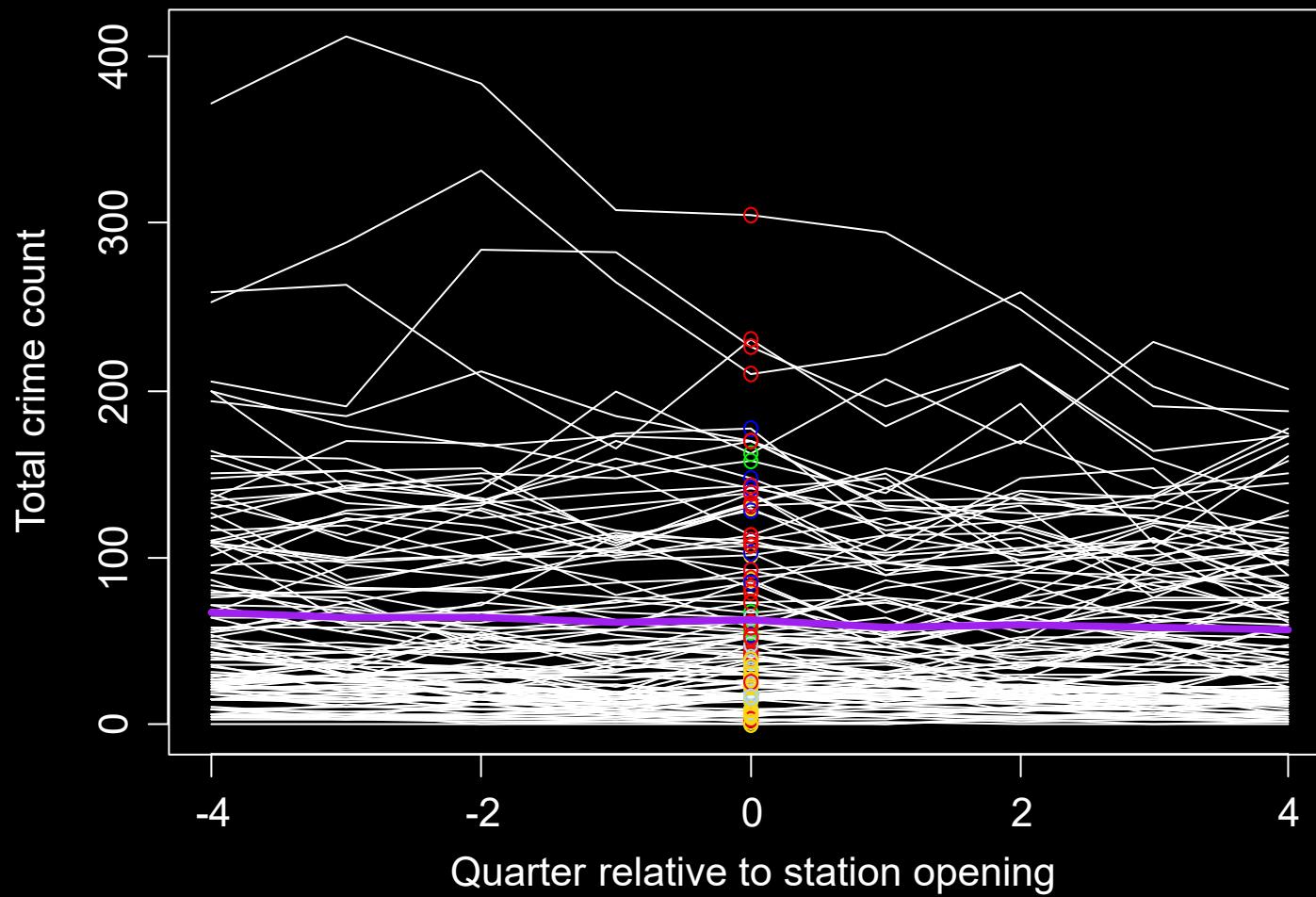
3% Increase When Station Opens, But Could Be Random
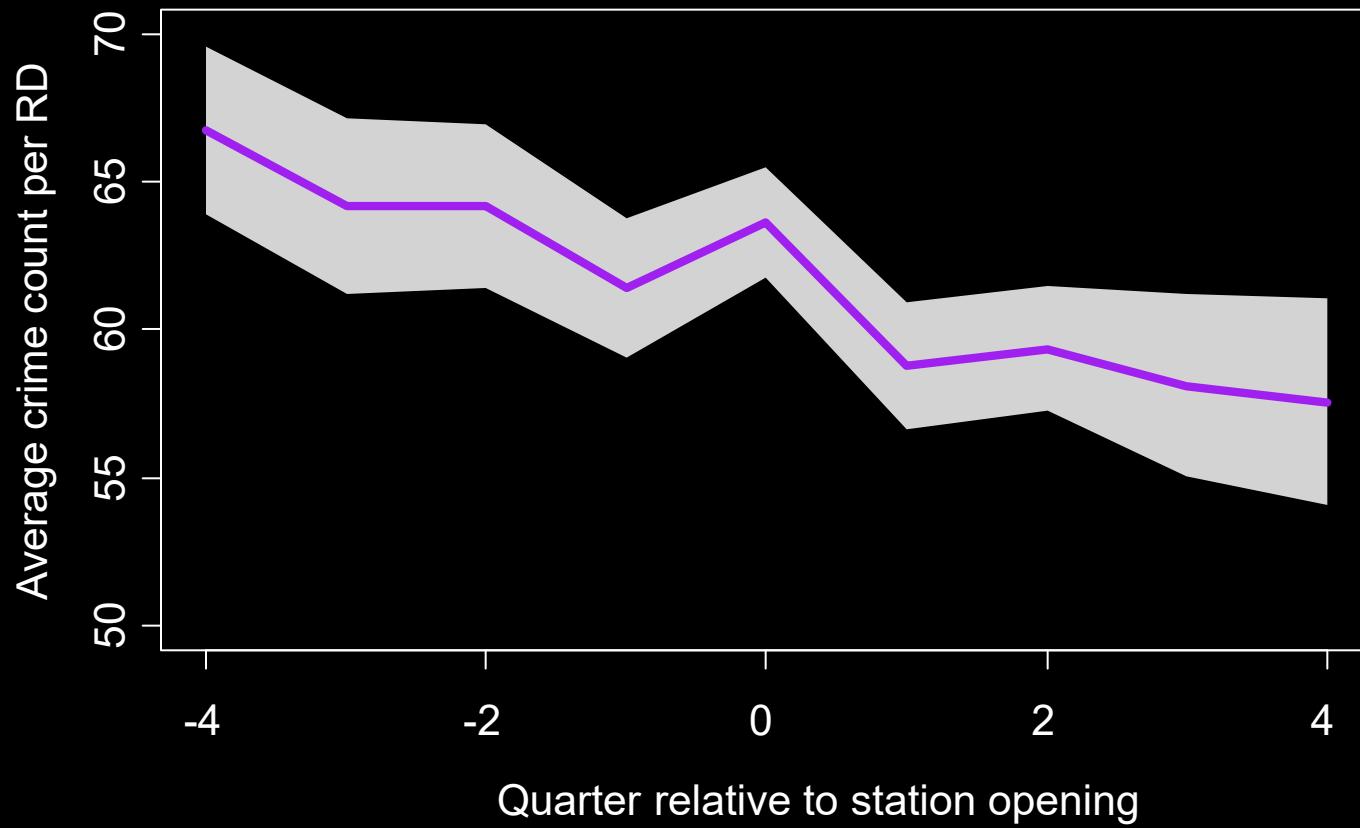
Station Openings Have a Minimal Effect on Crime

Crime type	% increase in crime when station opens	95% CI	p-value			
Total	2.7	(-3.1, 8.9)	0.43			

P-values calculated by randomly selecting a different nine quarter sequence from the same RDs

Effect of Station Opening Does Not Vary by Distance to Station

Crime type	% increase in crime when station opens	95% CI	p-value	% crime increase per km away from station	95% CI	p-value
Total	2.7	(-3.1, 8.9)	0.43	0.1	(-0.1, 0.4)	0.50

P-values calculated by randomly selecting a different nine quarter sequence from the same RDs

No Strong Relationship Between Station Opening and Distance to Station

Crime type	% increase in crime when station opens	95% CI	p-value	% crime increase per km away from station	95% CI	p-value
Total	2.7	(-3.1, 8.9)	0.43	0.1	(-0.1, 0.4)	0.50
Assaults	-0.6	(-9.9, 9.6)	0.91	0.0	(-0.5, 0.6)	0.97
Burglary/theft from vehicle	5.6	(-3.0, 14.8)	0.40	0.0	(-0.4, 0.4)	0.95
Burglary	1.5	(-13.1, 18.5)	0.85	0.5	(-0.2, 1.2)	0.26
Auto theft	6.6	(-5.8, 20.7)	0.23	0.1	(-0.3, 0.5)	0.83
Grand theft person	-8.7	(-28.6, 16.7)	0.51	1.2	(0.2, 2.3)	0.18
Homicide	-27.7	(-59.9, 30.4)	0.31	0.0	(-3.5, 3.5)	0.98
Robbery	0.6	(-9.0, 11.3)	0.92	0.1	(-0.6, 0.7)	0.88

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Strikes in 2000 and 2003 Shutdown Los Angeles Transit System

- 32-day strike from September 16-October 17, 2000

- 35-day strike ran from October 14-November 18, 2003

- Lo and Hall (2006) and Anderson(2014) showed strikes substantially disrupted transit

LOS ANGELENOS IMPACTED BY THE M.T.A. BUS STRIKE

METRO

Crime Appears to Increase Near Stations During the Transit Strikes
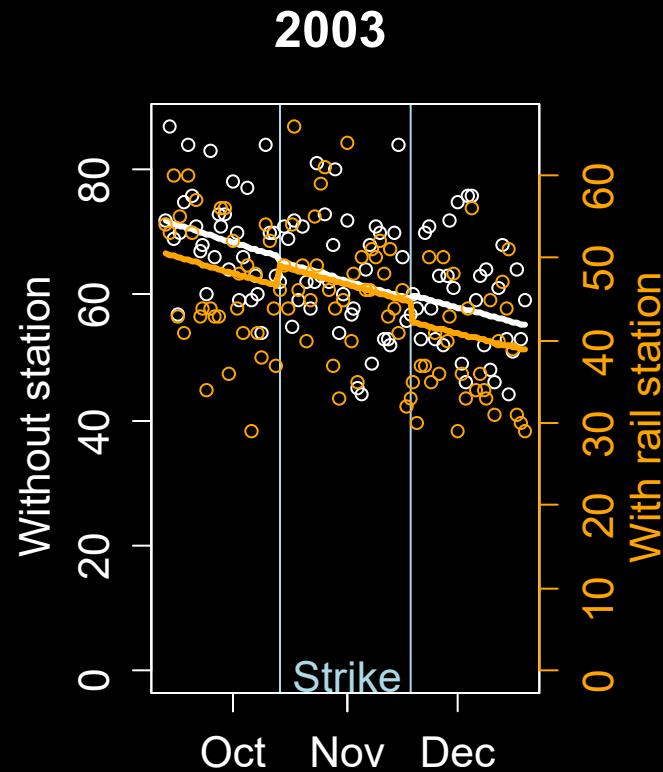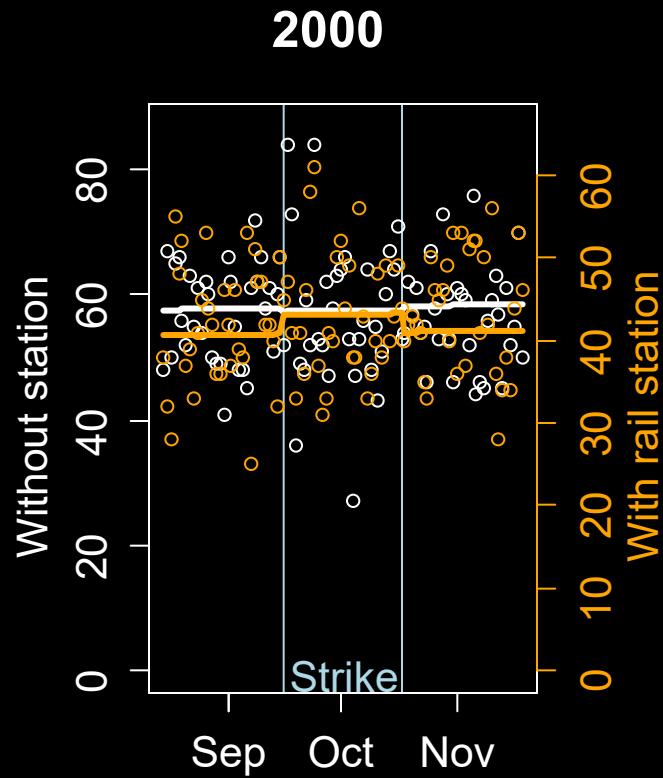
Compare Strike and Non-strike Periods and Transit and Non-transit RDs

$$\log(\lambda_{it}) = \beta_0 + \beta_1 \text{transit}_i + \beta_2 \text{strike}_t +$$
$$\beta_3 \text{transit}_i \text{strike}_t +$$
$$\beta_4 I(\text{year}(t) = 2003) +$$
$$\beta_5 I(\text{year}(t) = 2000)t +$$
$$\beta_6 I(\text{year}(t) = 2003)t$$

$$\exp(\beta_3) = \frac{\frac{\lambda_{\text{transit,strike}}}{\lambda_{\text{transit,}\overline{\text{strike}}}}}{\frac{\lambda_{\overline{\text{transit}},\text{strike}}}{\lambda_{\overline{\text{transit}},\overline{\text{strike}}}}}$$

Total Crime and Theft From Vehicles Increase During Strike

Crime type	Relative increase in crime at stations during strike	95% CI	Permutation p-value
Total	1.07	(0.99, 1.14)	0.068
Assaults	1.02	(0.87, 1.21)	0.79
Burglary/theft from vehicle	1.10	(0.98, 1.24)	0.15
Burglary	1.13	(0.95, 1.34)	0.18
Auto theft	1.06	(0.92, 1.21)	0.46
Grand theft person	1.06	(0.66, 1.70)	0.83
Homicide	2.22	(0.76, 6.51)	0.17
Robbery	1.00	(0.84, 1.19)	0.99

Public Transit Has Numerous Benefits, Neither Promotes Nor Hinders Crime

- Expansion of public transit has been justified as a basis for
  - reducing traffic congestion
  - improving economic development, and
  - reducing spatial mismatch of employment and low income households
- Neighborhoods often resist public transit expansion for fears that it will increase crime in neighborhoods
  - easier for criminals to travel to wealthier neighborhoods
  - increase the number of transient people to areas, generating signs of disorder
  - more potential victims traveling in relatively unguarded environments
- We find no impact of Metro Rail expansion on crime, positive or negative
  - Suggests crime should not be a factor for or against transit expansion

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Data Are Freely Available

- Crime data

1988-2004 – Los Angeles Public Library archives , OCR'd, row/column totals as checksums

2005-2014 – collected from incident level data

- Reporting districts are periodically renumbered, merged, or split
  - Crosswalked all RDs to 2005 shapefile using archived maps, Grogger's (2002) crosswalk, and recent shapefiles
- Metro Rail station openings posted at metro.net
- All data available at github.com/gregridgeway/LAPDcrimedata

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